Engineering Record

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Business Principles in Public Business

THE ACTION of the Secretary of the Treasury in setting definite classes into which the construction of post office and public buildings shall fall, these classes being dependent on the amount of business to be transacted in the building, will meet with well-nigh universal approval. Possibly members of Congress who have used public-building appropriations as evidence to their constituents of proper activity in the public interest, may dissent, but outside of that quarter intelligent opposition is not to be expected. The proposal to suit the building to its purpose is so evidently correct that discussion is superfluous. Nevertheless, the occasion should not be dismissed without an appreciation of the stand taken by the Secretary. If a rule founded on the same principle can now be framed and enforced for river and harbor improvements and then Congress be induced to place the allocation of the Reclamation Service's funds on a sensible basis, the pork barrel can be relegated to the museum of past congressional mistakes.

Uneconomical Truss Design

ALTHOUGH there are conditions under which it may be found necessary to design trusses with steep inclinations for the web members, the loss in economy which results can often be avoided. The building truss described on page 159 of this issue is an example of the excessively high stresses which result in the web members of a truss with steep diagonals, and of the resulting difficulties encountered in designing sections and providing joint details of sufficient strength. The use of tension diagonals sloping over the whole panel length of 27 ft. 3 in. for this truss, which is 22 ft. deep, would undoubtedly have resulted in appreciable saving, even though the short unsymmetrical end panel could not have been avoided. If intermediate loads must be supported, subdivided panels can be adopted with economy, and the diagonals designed with an inclination at least approaching the 45-deg. slope, which results in economical distribution of stress.

The International Congress

WITH final details of the International Engineering Congress rapidly being completed, it behooves those engineers who have not yet entered their subscriptions as members to act promptly and thus show the management that they appreciate its work. Necessarily the officers of the congress have worked under difficulties. The European war has curtailed the number of papers from foreign countries, but the list, nevertheless, is representative of much of the best thought of the entire engineering world. Roughly, one hundred and twenty-five of the papers are now in type, and the printing of the others is proceeding rapidly. The congress program is being molded into shape and the details of the entertainment features have been perfected. Naturally the representation of the congress from the Pacific Coast will be large. The engineers in that district have shown their loyalty in a striking manner, but since the congress is not a local affair but is even more than national in scope it is desired that the representation be as broad as possible. Aside from the mere matter of loyalty, the intrinsic value of the proceedings which will be distributed warrants hearty response to the congress' appeal. The advance copies of the papers to be presented, some of which this journal has been allowed to examine, promise most valuable contributions in every department of engineering assigned a place on the program. Without a doubt many engineers have concluded to join the congress, but in the customary fashion have carelessly put off the detail of writing and sending the necessary contribution. With the congress only a little more than a month away, now is the time for action. This journal cannot urge too strongly upon its readers that their response to the invitation to join should be no longer delayed. "Do it now" should be the slogan.

The West's Invitation

WHILE it is to be expected that many who will become members of the International Engineering Congress will find it impossible to attend, those who are able to make the journey are sure to be amply repaid. Not only will the sessions of the congress itself be well worth while, but the gathering of engineers brought together not only by the international meeting but also by the conventions, the preceeding week, of the national engineering societies and of the Pan-American Road Congress will be notable. The American Society of Civil Engineers has arranged an especially attractive social program and has extended an invitation to all engineers, whether members of the society or not, to participate. It is unlikely that there will be again for many a year so large and representative a meeting of engineers in this country. The engineers of the Pacific Coast, too, are doing everything in their power to arrange for the entertainment of their guests—and their reputation as hosts augurs well for the comfort and pleasure of those who attend the congress. But even aside from the congress and its entertainment, it is worth the time of any one, unfamiliar with the Coast and its spirit, to learn what that country is and what are its aspirations. With large visions as to the future, and energy and enthusiasm that are proverbial, a visit with the people of the Coast is an inspiration to every American. The coming meeting in San Francisco, therefore, is a most extraordinary opportunity for the eastern and the middle western engineer to broaden his engineering acquaintance, to gather new ideas on engineering subjects and to strengthen his patriotism by getting acquainted with the most progressive and one of the most virile sections of the country.

Self-Abnegation

DISCUSSING the meager compensation of engineers, a correspondent expresses tersely and vigorously indisputable views as to one of the chief causes. Engineers generally will agree with him—will heartily agree; but the difficulty is that they fail to "practice what they preach." No one denies that the engineer should be the director and not the follower, yet in practice he fails to assert himself and lets those with less ability, less knowledge of the subject, take the directing hand, generally, too, to the detriment of the work in hand. Our correspondent deserves quotation in full. He says: "During the past few years I have been associated with State, county, city and town engineers pretty steadily and have come to the conclusion that if the engineer is underpaid it is because he is constantly reducing the value of his services by his own tactics. A prominent engineer once told a lot of his brethren in my presence that their profession had the art of complete self-abnegation reduced to a science. And he was right. For example, one can go to the average engineer, especially in the East, ask him to consider a certain type of highway construction, let us say, and, after convincing himself of its merits, include specifications for this type on such roads or streets for which it may be suitable. Almost invariably the response will be that property owners, officials or certain politicians must first be seen, and, if they so instruct, he, the engineer, will prepare the specifications. Ask that same engineer if he will tell his physician what medicine to prescribe for him when ill and he would reply 'certainly not.' And yet the engineer should occupy the same relative position as regards any governmental body as the physician does to the individual. Let the engineer stiffen up his back-bone and insist on directing public improvements and not be simply a specification writer, and he will make his position so valuable that adequate compensation for his work will inevitably follow."

Pollution by Wash-Water

THE situation with regard to river pollution at Niagara Falls, N. Y., which has resulted in a court decision enjoining the municipal filtration plant from continuing its present method of disposing of wash-water and sedimentation-basin sludge, as set forth on page 160, is one which is not likely to arise with great frequency elsewhere. The unusual feature of the case is that the city is supplied with filtered water by municipal works and also by a private company—rivals in a keen competition for the local water-supply business. The city-owned plant is located upstream from the private plant and, it was claimed, polluted the water unduly at the company's intake 2 miles below by its wash-water and sedimentation-basin wastes. A number of waterworks experts testified and upon the data they presented Judge Laughlin based his decision. The case involved the principle of riparian rights which, the court stated, is founded upon the established rule that, while riparian owners do not own the water, each is entitled to a reasonable use thereof. It is not fair to assume that the case will serve as any general precedent. It would be a bold man indeed who would assert that one filter plant 2 miles upstream from another is necessarily a menace from the standpoint of pollution. In matters of this kind local conditions place each case in a class by itself, and into the problem there enter the complex elements of river currents and dispersion, in addition to the amount and character of the waste discharged. Still, the case is interesting, for it illustrates that an agency whose primary object is to protect the health of its patrons has itself been accused of complicating precisely the same task for its competitor. It can be argued that the city plant puts back into the river, in concentrated form, exactly the same substances which were there originally, with the exception of the chemicals. It then becomes necessary to determine to what extent this concentration is objectionable. Obviously no general formula will give the solution to this problem.

Justice—But Only Within Arbitrary Limits

EARLY in July the Public Service Commission for the Second District, New York, handed down a decision which holds, in substance, that the Legislature has empowered it to reduce rates, but not to increase them above certain maxima. In other words, while the authority of the commission is unlimited as to the service it may require from the roads, and as to its power to do justice to the public, its authority to increase rates and to do justice to the carriers is limited by maxima set by a Legislature unqualified for the task by experience or the possession of evidence as to cost of service. "Justice you may expect, but only if the 'just and reasonable' rates, guaranteed you by law, are within the two-cent and the three-cent maxima"—that, in effect, is what the commission says to the railroads.

The case in question was that of the Ulster & Delaware Railroad, petitioning for permission to raise its rate on mileage books from two to three cents a mile. The railroad company supported its petition by a careful report made by William J. Wilgus, consulting engineer, New York, a report convincing to the minority of the commission, which declared in favor of granting the railroad company the relief it requested. The majority, three members, including the chairman, did not pass upon the merit of the railroad company's application, so far as the showing of cost was concerned, but confined itself entirely to the question of jurisdiction.

It appears that before the Public Service Commission law was enacted a two-cent maximum rate for mileage was specified by statute. This law not only fixed the maximum rate, but forced all railroads in the State, over 100 miles long and organized subsequent to the act, to sell mileage whether they desired to do so or not. When the Public Service Commission law was passed this mileage act was not repealed, and later, on a recodification of the statutes, the mileage law was retained. Resting upon these facts, the majority of three holds that it was the intention of the Legislature to give the commission power over rates only within the maxima, despite the fact that it is expressly stated in the Public Service law that if the commission finds a rate insufficient to yield reasonable compensation for the service rendered it shall determine a new rate thereafter to be charged.

It cannot be denied that there is, to some extent, inconsistency in the legislative enactments. Two of the commissioners, holding fast to the theory that the setting of maximum rates by an uninformed Legislature is absolutely incompatible with the theory of commission control, have dissented from the prevailing opinion, holding that the railroad company should be permitted to raise its mileage rate to three cents.

The case is not without precedent in commission history, though, of course, it has not previously arisen in New York State. A similar situation arose in Missouri, and has resulted in the confirmation by the State Supreme Court of the full power of the commission, the finding being that the enactment of the commission law *ipso facto* set aside all previous rate enactments by the Legislature.

There is no ground for argument, in the judgment of this journal, as to the soundness of the finding of the Missouri tribunal. Commission control has come because a long and very unfortunate history of Legislative control in railroad matters demonstrated that those bodies could not intelligently supervise the relations between the public and the carriers. To an extent, it is a scientific solution of the haphazard system of control by the Legislature. The entire principle must fail if the authority of the regulating body is to be arbitrarily restricted. Despite the apparent confusion in the New York laws this journal does not doubt in the least that the Court of Appeals, if the case is carried to it, will uphold the authority of the Public Service Commission and declare that the setting of maximum rates by the Legislature is inconsistent with the law under which the commission operates. No other decision is possible if commission control is to succeed.

Giving the Railroad Employee a Better Chance—A Suggestion, Too, for Every Employer

THIS JOURNAL has heretofore deplored the haphazard way in which most railroads hire and promote their technical men. Doubtless the same system, or lack of it, obtains in almost every department of the railroad, and in a recent address to the Burlington Association of Operating Officers George M. Basford, chief engineer of the railroad department of J. T. Ryerson & Son, New York, outlined a remedy in the appointment of a special official who would report directly to the president and have the final word in all matters of employment and promotion. When a vacancy was to be filled each officer would have a chance to put forward his favorite candidate, but the special official would make the selection.

A man capable of filling such a position, Mr. Basford admits, would be hard to find, but that is only added proof that he is badly needed. Certainly some means must be found, if railroad officials, both important and petty, are in the future to measure up to their increasing responsibilities, of insuring that every employee in the great organization, except possibly the unskilled laborer, shall have a fair chance to show what he can do, and this not merely to a dull and unappreciative immediate superior whose own mediocrity damns his whole staff. The central officer will have opportunity to weigh in one balance all of the men doing one kind of work, and every man will have a chance and incentive to grow.

As to the details of the plan, Mr. Basford described a method used successfully by a certain superintendent of motive power. This official had a card form made out which bore the name, age and occupation of each employee and then tabulated his standing—"Very Good," "Good," "Medium" or "Poor"—under twenty-two heads. These included education, special knowledge and experience; personal virtues, such as honesty and temperance, and then a list of individual attributes, such as tact, reliance, foresight, initiative, assertiveness, accuracy, system, executive ability. These cards were filled out, signed and dated by the immediate superior of each man—the foremen listing their men, the general foremen doing the same with the foremen, and so forth. The cards were all sent to the superintendent himself, the senders not being allowed to retain copies, and every six months a new lot of cards was made out.

It can readily be seen, as Mr. Basford pointed out, that such a system puts the petty officer himself more or less on trial. It will not do for him to fill out his cards by guesswork; he is forced to study his men. Otherwise the contradictions of his records will come back on him. This journal suspects that there will be some who, failing to see the importance of the plan, will violate the rules, keep duplicates of the data sent in, and simply copy them on the new cards. The extent to which this practice can go on will presumably depend largely on the personality and influence of the central officer. If he administers his office with sagacity and shows the men of all rank that proved merit is to be recognized, and by the same token that a good rating in "Honesty" is as imperative as tact, resource, energy or organizing ability, an *esprit de corps* will be created and the practice is not likely to go long undetected. If he simply makes his office another department, and turns the detail over to narrow and unsympathetic clerks, the whole system will become a farce. Above all, the central officer himself must be absolutely free of the taint of favoritism.

To apply such a card system to the engineering departments would be no easy task. These men, perhaps more than any others in the entire organization, need individuality, characteristics that cannot be defined and graded. Along with the other information on the cards there should be ample space for remarks. In the general designing departments the men who despise track work and love pressure lines and secondary stresses should be differentiated from those who revel in yard layouts but have no taste for structural complexities. Others do not belong in the designing departments at all, but should be out directing construction work. Some, without being specialists in anything, are very adaptable and can be relied upon to produce results in almost any emergency, while others of rather narrow vision and no executive ability may be capable, if given free rein, of evolving something of great value in the nature of research. Among the officials there may be similar differences that cannot be designated by "Good" or "Poor" opposite a single word. There are those who are engineers first, last and all the time, with only secondary interest in the other branches of the railroad business, while there are others who lean heavily toward operation, or law. In short, in any worth-while cataloging of engineers tables of measurable virtues must be supplemented by carefully prepared estimates of non-measurable characteristics.

Mr. Basford's plan deserves serious attention. The railroads are not building their engineering organizations for the future, as they are their equipment and permanent way. Too intent on the work of the immediate future, they are not developing men to handle the work of next year. When they have money they hire too quickly; when they run short, fire too quickly. In the past there has been a glamour in railroading, which has largely disappeared since the fall of the railroads from public grace. More than one conscientious and industrious engineer with five or ten years' railroad experience is advising young college-graduate friends to stay out. It behooves the railroads to take steps to get and keep their share of the engineering talent for what should be second to none as a civil-engineering field.

Effect of Interference of Official Body in Engineering Plans

BY VOTING to build a tunnel near the Queensboro Bridge rather than to use the bridge itself for rapid transit operation, the Board of Estimate and Apportionment, of New York City, has emphasized an interesting engineering problem, and also emphasizes the mistakes likely to be made when an official body goes counter to the recommendations of engineers specially qualified for and detailed to study a complicated engineering problem. When the Dual subway system was placed under contract it was planned that the trains of the Broadway subway should cross back to Long Island over the bridge. This involved the objectionable operating feature of raising the trains from below ground to a height of some 150 ft. above the water level. Nevertheless the bridge represented an exceedingly heavy investment and it was natural, therefore, to attempt to use it in any scheme of rapid transit development involving the crossing of the East River in the mid-town section.

Probably with this in mind and also because it was claimed that the placing of the subway trains on the bridge would decrease materially the capacity for vehicular traffic, the board has voted for the tunnel scheme. This action was taken on a proposal from a contractor to do the work for a sum certainly smaller than will ever be offered the city again. The contractor in question is said to be heavily interested in terminal projects in Queens that are expected to develop a heavy motor-truck traffic across the bridge.

There is no question that the action of the board has been taken in the best of faith, for the good of the city, as the board sees it. The backers of the terminal project are, of course, creating additional taxable values in Queens, which will give the city desired additional assets. The abandonment of the use of the bridge, however, is, in the judgment of this journal, a mistake, not only because it increases the cost of the Dual system about $2,500,000, but because it will cause an undesirable traffic routing condition, will delay the completion of the system and, finally, may prevent entirely the best development of the traffic problem between Manhattan and Long Island.

As has been pointed out the additional cost of the Dual system will be about $2,500,000, this being the lowest estimate that has been made. Furthermore, the whole matter of the operating contract for the system has been reopened. Although the designing staff of the Public Service Commission is bending every effort to complete plans for the change, the work will have to be relet and the shortest time for the completion of the tunnel is thirty months after the letting, this estimate having been made by an experienced tunnel contractor. The full operation of the Broadway subway, therefore, will probably be delayed a full year. Moreover, the extra expenditure and delay have been incurred in the face of the difficulty the city has in meeting its expenses and providing at the same time for subway construction—a difficulty that emphasizes the need of putting the new subways in operation as soon as possible.

As to the contention that the remodeling of the bridge would decrease the capacity for carrying vehicular traffic, it appears that the present roadway is 52 ft. wide and in that width contains two trolley tracks. Had the bridge been remodeled it would have contained at this level one roadway, about 28 ft. wide, with the two subway tracks on the north side. On the upper deck, which now has provision for four tracks, there would have been another roadway of the same width, with two elevated tracks on the south side. The approaches to this upper roadway would have been steeper than was desirable for horse-drawn loads, but well within the capacity of even the largest motor trucks.

The most serious questions, however, from the transit point of view, are that additional facilities are now being provided where they are not needed, and never will be needed, and that this construction will probably have the effect of deterring the city from building a tunnel farther up the river. The present facilities now building in Queens can supply about eighty trains an hour to the Steinway tunnel and the crossing at the bridge. Under the rejected plan, these two crossings could have cared for 120 trains an hour. The new plan will provide enough capacity to care for the population of Queens for a generation. This means that all future transit lines for that borough will pass through the Long Island bridge plaza, repeating, at first in miniature, and later on full scale the present deplorably congested conditions of the rapid-transit lines in the Borough Hall district of Brooklyn. The fact that the protest of the Brooklyn property holders in the Borough Hall section compelled the Dual system tunnel to be built through these already crowded streets, against the advice of the Public Service Commission, is enough to indicate that, having gotten a tunnel at Blackwell's Island, property holders in the lower corner of Queens will never allow the construction of another tunnel farther up the river.

In the opinion of this journal, a route extending the new Broadway subway up Central Park West to Eighty-Sixth Street and thence across the city, under the East River and out through the towns along the Sound is going to be sorely needed. This scheme would serve Queens much better than that of carrying every passenger from the Borough through one point—the Long Island bridge plaza.

Be it said to their credit that the engineers of the Public Service Commission have strenuously opposed the change which the Board of Estimate has made. They have been criticised for using the bridge as a link in planning the rejected layout, but the bridge was there or was under way before the Public Service Commission was in existence and they were expected to use it. The engineer, alas, is often remembered by his work long after the actions of boards and commissions that hampered his efforts are forgotten.

LOCATION OF THIS STATION IMPOSED SEVERE CONDITIONS IN DESIGN

Swedish Government Builds Hydroelectric Plant Above the Arctic Circle—Part 1

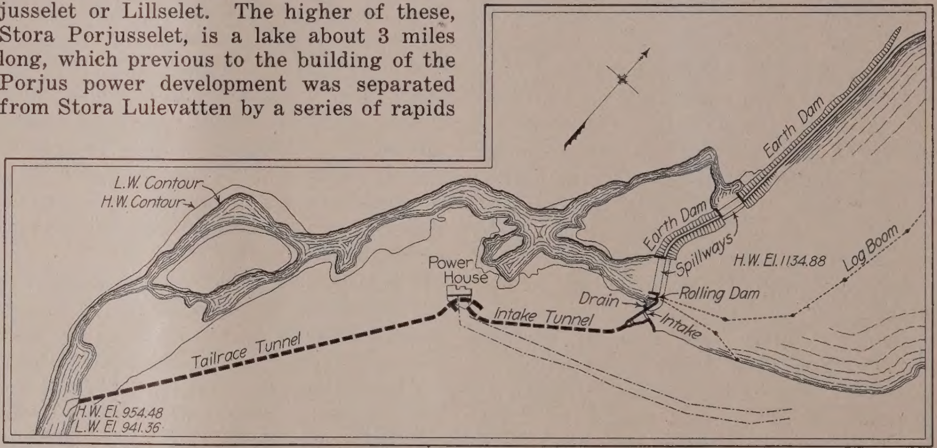
Prevailing Severity of Winters Results in Unusual Designs to Insure Continuity of Service in Spite of Ice Conditions

IN 1904 the Swedish Government, realizing the value of the water-power resources of the kingdom and the part they might be made to play in the country's economic development, took steps toward the acquirement and utilization by the State of certain water powers. The investigations, legal proceedings and plans progressed slowly, but the first plant, that at Porjus, just above the Arctic Circle, has now been placed in operation. The economic features will be discussed editorially in a later issue, and this article, therefore, is devoted to a description of the striking features of the design.

The dam, to be described in the first installment of the article, is unusual chiefly in the employment of arches instead of slabs in the decks of the hollow dam and in the provision of a sliding wedge of rock in the earth dams to insure continuous support of the core wall despite settlement and shrinkage.

In the subsequent sections of the article space will be given to the intake and discharge tunnels and the power station, all underground as provision against interruption by ice. The forebay, the differential regulation of the tail-tunnel, and certain other details depart materially from customary practice. The drawings, photographs and part of the text here presented were obtained from the Swedish Royal Water Falls Commission. The text has been revised and expanded, however, by A. G. Hillberg, hydraulic engineer, New York City, who has for some years been collecting data on the plant.

The Porjus falls is the general name for a series of rapids and falls about 1½ miles long, between two comparatively calm pieces of water, Stora Porjusselet and Lilla Porjusselet or Lillselet. The higher of these, Stora Porjusselet, is a lake about 3 miles long, which previous to the building of the Porjus power development was separated from Stora Lulevatten by a series of rapids 2 miles long, the so-called Luleluspen, with a fall of about 28 ft. The building of the dam at Porjus has raised the surface of the lake, so that its additional head can also be utilized for the power works almost to its full extent.



ICE CONDITIONS REQUIRED TUNNELS FOR INTAKE AND DISCHARGE LINES

The gross head at the power works at low water is 187 ft., and at high water, 180 ft. After making a deduction for friction losses in the conduits above and below the turbines, and for water hammer due to sudden changes in load, the net operating head is from 166 to 180 ft.

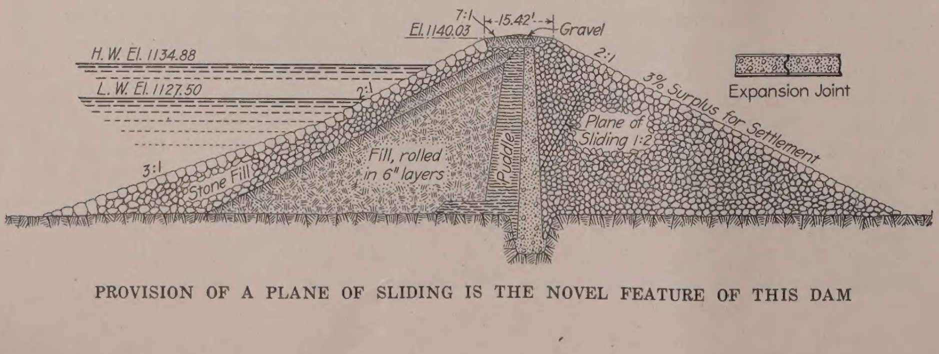
The design of the power works may be seen from the accompanying plan. The material on both sides of the stream is rock, covered in part with a thin layer of soil or sand.

The conduits were located on the east bank, this affording the most direct route and the most advantageous topographical conditions. Hence the intake is at the east abutment of the dam. Owing to climatic considerations it was thought desirable, when determining the situation of the power plant, to obviate long exposed tubes. Various plans were figured for comparison, and as the character of the ground was declared after a geological investigation to be satisfactory, the decision was made that the generator room should be located underground, and that the water should be conveyed to and from the turbines in tunnels, blasted in the solid rock. This arrangement insures continuity of the water supply during the winter. As the reservoir during the winter is covered by ice, often 4 or 5 ft. thick, the only place in which water comes into view is in the forebay at the lower end of the intake tunnel.

THE DAM

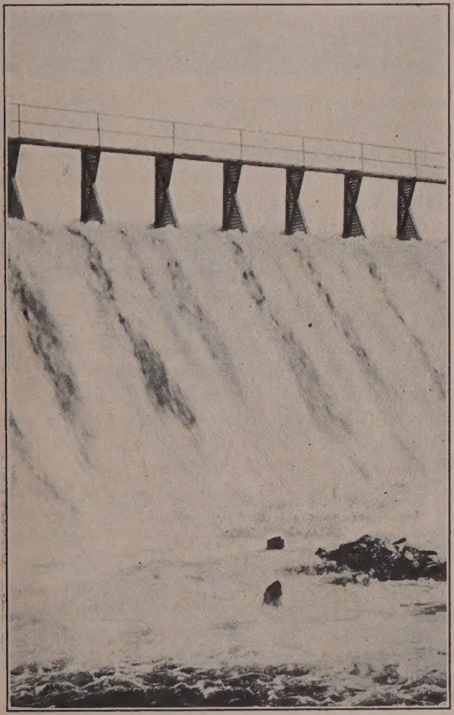
In designing the dam structures the forces exerted by the expansion of the ice under the action of the heat of the sun had to be considered. To build a dam so strong that it could prevent the expansion of the ice, that is, resist a pressure equal to the crushing strength of the ice, was out of the question for both practical and economic reasons, as such a structure would require masonry of too heavy dimensions. It was, therefore, decided to use earth dams with stone facing on the upstream side, which would admit compression of the earth fill without injuring the dam.

A cross-section of the dam is shown. It consists principally of three parts, the stone fill on the downstream side, the dirt fill on the upstream side and a core wall of reinforced concrete carried to rock. The dirt fill consists of several parts, of which the middle has been carefully rolled and constitutes the waterproofing membrane. Over the dirt fill is a cover of puddle and stone in order to protect it from the action of frost and ice.



PROVISION OF A PLANE OF SLIDING IS THE NOVEL FEATURE OF THIS DAM

The stone fill on the downstream side serves as support for the core wall. In order to make this support more effective the fill has been built with an inclined plane of sliding. This was done, so that, should the stone fill settle, there will always be a direct transmission of the pressure from the core wall to the supporting fill. When that part of the stone fill below the plane of sliding settles, the wedge-shaped upper part will slide against the core wall because of its weight, thus exerting an active pressure. The amount of this pressure, by shifting the location of the plane of sliding, has been so proportioned that it balances the pressure of the dirt fill on the opposite side of the core wall. The additional load on the core wall, because of the water pressure, is taken by the wall by means of reinforcement placed in its upstream side. Furthermore, the core wall has been anchored to the rock to insure cantilever action. The reinforcement in the wall is also ample to prevent cracking of the concrete. A certain amount of reinforcement has also been provided at the downstream side to take care of unbalanced pressures during construction, such unbalanced loads being due to the fact that the dirt fill, on which the work had to be suspended during the winters, rose slower than the stone fill.



NEEDLE DAM SECTION OF SPILLWAY WITH BRIDGE READY TO BE COLLAPSED

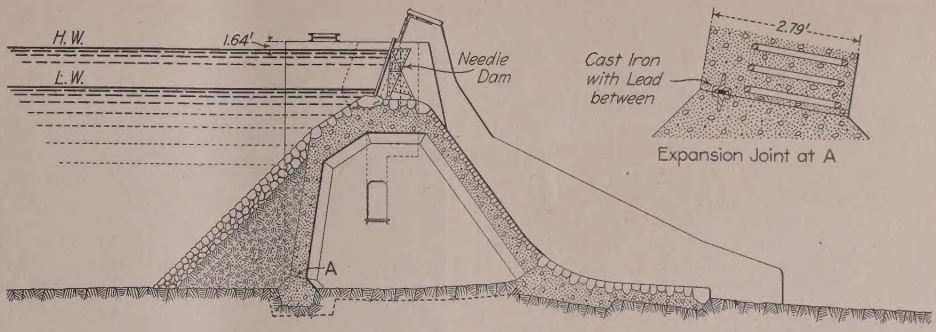
In order to ascertain whether or not the dam remains tight, an inspection gallery has been provided in one section, for 400 ft., through the stone fill at the base of the core wall.

SPILLWAYS

Over the west branch of the river between the earth dams, and over the major part of the width of the main branch, the dam consists of concrete spillways. The west spillway is 270 ft. long, while the east is 378 ft.

The upstream side of the crest is inclined. This was done in order to force the ice to break up and be pushed over the crest. A stone-protected dirt fill, furthermore, has been placed in front of the dam to insure against leakage.

The spillway structure is a modified Ambursen dam. It consists of concrete arches between concrete buttresses. The thickness of the buttresses is 4.92 ft. and the free span of the arches is 19 ft. The interior radius is 22.3 ft., corresponding to a rise of about 2.14 ft. The arches in front, against which the fill rests, have a curved exterior, while the arches forming the crest of the dam and the downstream side are covered by a flat concrete deck paved with stone set in mortar. These latter parts of the structure and especially the dam crest have been given heavier dimensions because of the action of ice. The stone facing, which has been securely anchored to the concrete, has been considered as loading only and its strengthening effects have not been incorporated in the calculations.



HOLLOW SECTION HAS STONE FACING FOR PROTECTION AGAINST ICE

Because of the reactions from the arches, which at the ends produce big horizontal forces, it was necessary to build solid sections at both ends of the dams. About 30 ft. at each end of the west spillway have, therefore, been made solid. The east spillway, which, because of the ground profile, is somewhat higher, has at its west end a solid portion about 46 ft. in length. Its opposite end abuts the gravity-section dam below the log sluice, the mass of which is sufficient to resist the horizontal pressure. Because of the necessity of bypassing the water during the construction period, the east spillway had to be built in two parts, thus requiring a solid section at the midpoint. As this portion, however, had to resist the horizontal component due to the dead load only it is about 29 ft. in length.

CONCRETE PROPORTIONS AND WATERPROOFING OF DAM

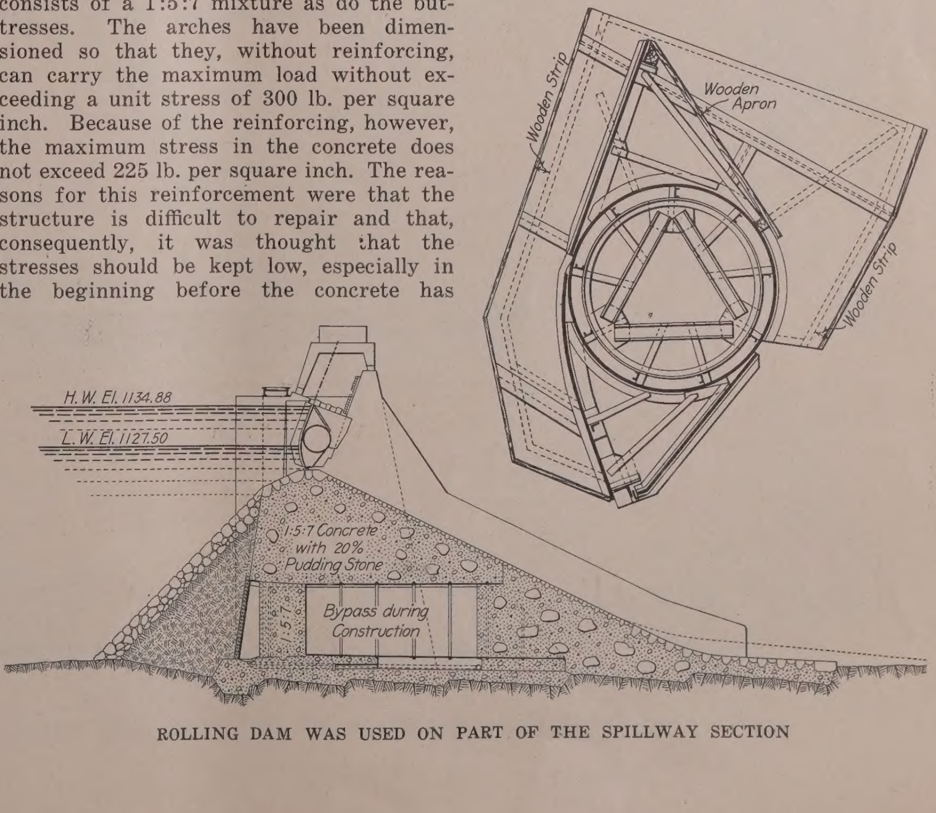
The concrete in the arches is a 1:3:5 mixture with the exception of an 8-in. waterproofing layer on the upstream side. The mixture in this layer is 1:2:2½. The concrete deck over the arches, however, consists of a 1:5:7 mixture as do the buttresses. The arches have been dimensioned so that they, without reinforcing, can carry the maximum load without exceeding a unit stress of 300 lb. per square inch. Because of the reinforcing, however, the maximum stress in the concrete does not exceed 225 lb. per square inch. The reasons for this reinforcement were that the structure is difficult to repair and that, consequently, it was thought that the stresses should be kept low, especially in the beginning before the concrete has attained its maximum strength. The reinforcing, furthermore, holds the structure together and prevents cracking.

In the construction joints between arches and buttresses tightness has been insured by means of asphalt felt. The paved concrete deck at each buttress is provided with an expansion joint, tightened by means of oakum and tar painting. To insure tightness along the upstream toe the arches and buttress have been carried down about 3½ ft. into good rock. Between this cutoff and the arches proper there is a joint permitting the arches to deform without cracking under varying loads and temperatures. The joint has been made watertight as shown by means of lead strips placed in frames of cast iron, which in turn have been anchored in the concrete on both sides of the joint.

On the downstream side of the dam the arches abut an apron of concrete and stone paving.

The upstream side of the front arches has been covered with cement plaster and painted twice with an asphaltic solution. The degree of tightness attained by these precautions has been shown by measuring the leakage, which, half a year after the filling of the pond, amounted to only 1½ gal. per second.

In the original plan it was intended to use the volume of water between El. 1127.50 and El. 1129.11 for pondage. The crest, therefore, was to be provided with re-

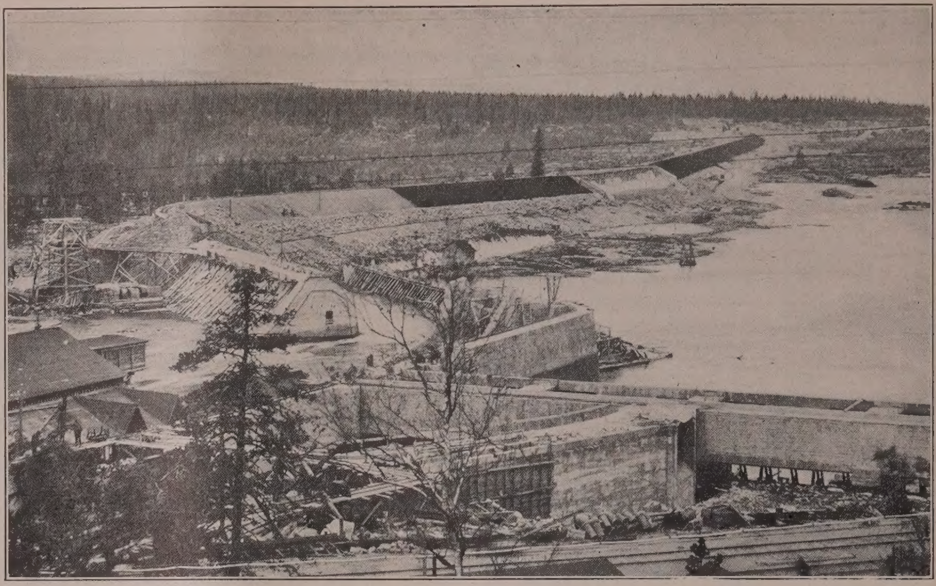


ROLLING DAM WAS USED ON PART OF THE SPILLWAY SECTION movable bents and flashboards of wood, which each year were to be taken away before the spring flood and replaced later on. During the construction period, however, the Legislature determined to complete the works for the first regulation of the available water supply. The collapsible sections on top of the spillways, therefore, have been built so that they permit the raising of the water surface to El. 1134.88. The movable dams consist of structural steel bents supporting wooden needles. These bents are hinged at the base and can be laid down on the crest of the dams. In order to stiffen them they have been covered with perforated steel plates. They are manipulated by means of chains.

ROLLING DAM

As stated above, the east end of the east spillway abuts the log sluice. This sluice is 39.36 ft. wide and is closed by a rolling dam. The shape of this sluice is shown in one of the accompanying drawings. Its crest is 3.28 ft. lower than the spillways. The upstream side is protected in the same way as that of the spillways, but the downstream side has a slope of 1 : 2 in order to facilitate the passage of the logs. Between this incline and the rock foundation below the dam is an apron similar to that of the spillways. On both sides of the sluice there are wing walls 10 ft. thick, in which are placed the recesses for the rolling dam. The log way on the downstream side is flanked by walls 6½ ft. high, protected by stone facings anchored securely to the concrete.

Through the masonry below the rolling dam were five sluices, which during certain periods of the construction served as bypasses for the river discharge. As shown in one of the illustrations these sluices had an interior steel plate lining, which, furthermore, was protected by an interior lumber sheeting. When the structure was completed and the water had to be raised, these sluices were closed by means of stoplogs lowered in slots on the upstream side, and after the planking had been taken out the sluices were partially filled with concrete. The leakage between the stoplogs was carried away in pipes as shown. The apron and the adjacent part of the dam were built in connection with the closing of the sluices.



CONTOUR REQUIRED AN EXTENSIVE DAM SYSTEM

The rolling dam, of which a cross-section is shown, was built in accordance with drawings made by Maschinenfabrik Augsburg-Nürnberg, A.-G., Germany. It consists of a cylindrical mantel of steel plate with an interior diameter of 5.15 ft. The over-all length of the roller is 44.02 ft. It is provided with a sheath in two parts, one extending from the cylinder downward to a wooden tightened strip, the other extending upward. The reason for building the sheath in two parts was that when the roller was ordered it was intended to put on the lower part only, but make the structure strong enough to permit the addition of the upper portion later on. Before the rolling dam had been completed, however, and shipped from the works, the Legislature passed the previously mentioned resolution with respect to the lake regulation, and the rolling dam, could, therefore, at once be given its full height of 11½ ft. The other details of the roller are the same as described in the Engineering Record of Dec. 13, 1913, page 654, in the article entitled "Design of Rolling Dams."

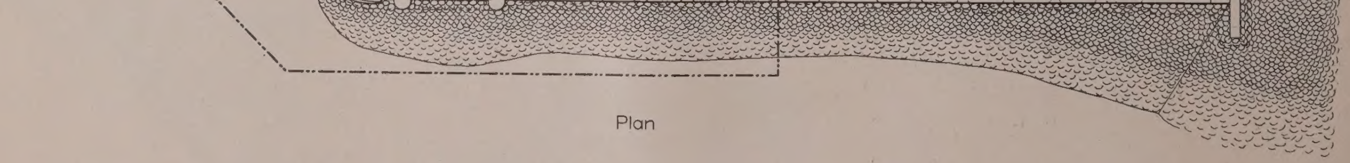
The builder of the rolling dam and its appurtenances was the firm of Nydqvist & Holm, Trollhättan, Sweden.

Between the rolling dam and the intake on the east shore the dam structure has such a position that ice pressures are not to be feared. It was, therefore, found feasible to build a gravity-section dam with the upstream side nearly vertical, and of the common triangular cross-section shown.

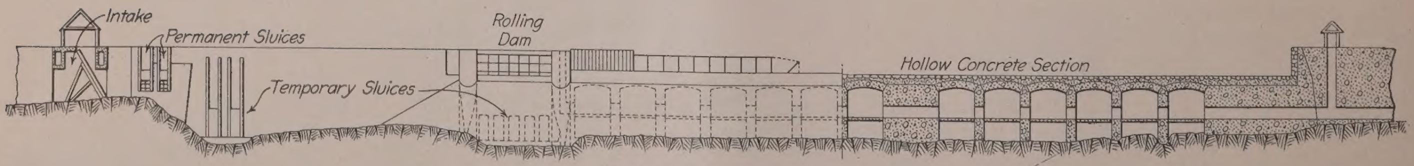
Adjacent to the intake are two permanent sluices, which are 5 x 5 ft. in section. The gates are made of steel and have been designed for hand operation.

In the crest of the dam next to the log sluice is a smaller opening closed by stoplogs. This opening has been provided so that, if desired, in the future, a logging flume can be connected to it. At the other end of the dam, next to the intake, is an ice sluice, 13 ft. wide and 2½ ft. deep below the water level. This opening is also closed by stoplogs.

The dam has been reinforced by counterforts on the sides of all openings. It has a waterproofing layer on the upstream side, inside of which is a system of drains. The total length of the dam is 4100 ft., of which



Plan



Sectional Elevation A-A

DAM SYSTEM AT PORJUS HAS SPILLWAY WITH BOTH ROLLER AND NEEDLE SECTIONS

3220 ft. consist of the earth dams and 648 ft. of the spillways. The following quantities in cubic yards had to be handled:

Earth excavation	44,600
Rock excavation	25,900
Masonry of mass concrete and stone	32,600
Reinforced concrete, etc.	22,500
Earth fill	132,800
Stone fill	146,500

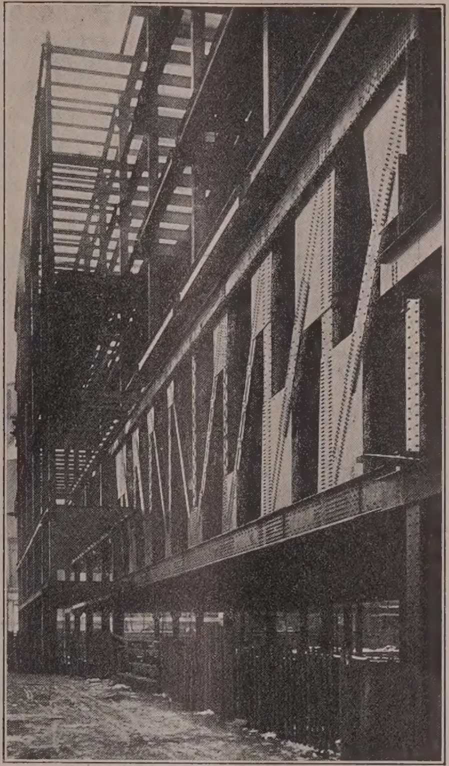
At high water the dams can discharge 54,800 sec-ft. The maximum volume of water in the river during floods is about 53,000 sec.-ft.

(To be Continued.)

High Stresses Carried by Heavy Riveted Truss

Clear Loading Platform at First Floor of Mannheimer Building Furnished by the Use of 119-Foot Truss Supporting Eight Floors

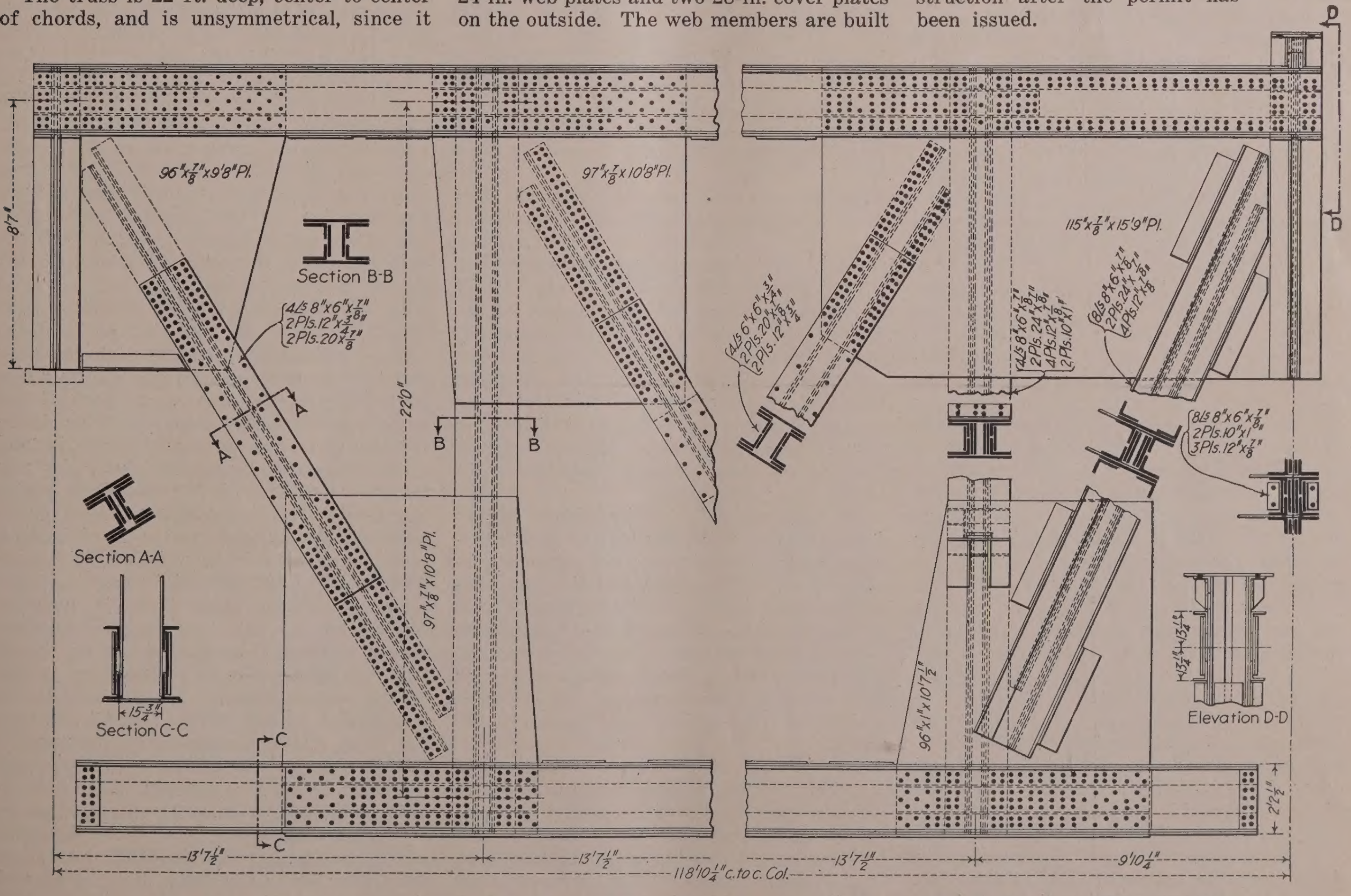
UNUSUALLY heavy riveted-truss construction resulted from the requirements for clear space at the shipping platform for the purpose of loading and unloading goods imposed by the owners of the new Mannheimer Building in St. Paul, Minn. The truss illustrated in the accompanying photograph is about 119 ft. long and supports four columns of the seven-story building. Provision for another story is made in the design, and the specified floor load of 220 lb. per square foot on the first four floors and one mezzanine floor, of 265 lb. on the fifth floor and 190 lb. for three upper floors, combined with the dead load, resulted in high stresses in this truss, many members being subjected to a total maximum stress of over 2,000,000 lb.



HEAVY RIVETED TRUSS 119 FEET LONG SUPPORTS EIGHT FLOORS OF BUILDING

The truss is 22 ft. deep, center to center of chords, and is unsymmetrical, since it supports four bays of the regular column spacing of 27 ft. 3 in. and one short end panel 9 ft. 10¼ in. long. Two panels per bay were used, so that the truss contains nine panels with diagonals of rather steep inclinations. The chords are built of ⅞-in. material, using four 8 x 6-in. angles, four 24-in. web plates and two 28-in. cover plates on the outside. The web members are built of angles and plates with latticing or tie plates as seen in the photograph. The extremely large ⅞-in. gusset plates and splices are noteworthy. In the end diagonals the rivets were placed in double shear by the use of outside plates in the 27-ft. 3-in. panel, and outside plates and angles in the short end panel, as shown by the accompanying detail drawing. The maximum stress in the web members occurred in the steep end diagonal and is about 2,146,000 lb. The maximum chord stress is 2,344,000 lb. The bottom chord is slightly below the mezzanine floor level, and the top chord 3 ft. 5 in. below the third floor level, the second floor and mezzanine floorbeams being supported by the vertical web members of the truss.

This building is owned by the Mannheimer Realty Company of St. Paul. The architect is A. H. Stem of St. Paul, and the engineer, O. S. Payzant of New York. The steel was fabricated by the Minneapolis Steel & Machinery Company of Minneapolis.



DETAILS OF END PANELS, SHOWING LARGE GUSSETS—DIAGONAL CONNECTIONS WITH RIVETS IN DOUBLE SHEAR

THE BUREAU OF SANITARY ENGINEERING, Department of Health, State of Maryland, covers the State in four divisions, with a resident engineer in charge of each division. His duties are to investigate the sanitary conditions with reference to the public water supplies and systems of sewerage and sewage disposal, and also to investigate typhoid epidemics. It is required under the laws of Maryland that, before any such systems are constructed within the State, plans and specifications must be submitted to the Department of Health for approval, and a permit issued. The resident engineer in charge of the division sees to it that this law is complied with and supervises the construction after the permit has been issued.

Solar Declinations Computed by Graphic Method

Practical Field Rules for Drafting Curve for Use with Any Solar Attachment—Found Preferable to Computation

By ROBERT R. V. REYNOLDS
Forest Service, Washington

THE PRACTICAL field method here outlined for obtaining solar declinations for use throughout the day with any solar attachment will be found preferable to computation, because of the comparative ease and certainty of getting results. Use any notebook having pages ruled into small squares or rectangles, and with a sharp, hard pencil proceed as follows:

1. At the left of the page, as shown on the sample page, write a vertical column of hours (apparent time) from 4 a. m. to 6 p. m., placing one hour upon each consecutive horizontal line.

2. Change the longitude of the station from Greenwich into hours and tenths by dividing it by 15.

3. Beginning from the line of 12 (apparent noon), measure up the page the hours and tenths derived from the longitude, and through the point thus located draw a line across the page parallel to the hour lines. This line graphically represents Greenwich noon in relation to the local meridian.

4. Refer to the Ephemeris and number the vertical lines of the page to correspond to the successive minutes of the angle in declination which the sun will pass through on the day for which the curve is drawn, progressing from right to left. Write the degrees of declination above. Each ruled square on the page then equals 60 sec. of declination, considered across the page, and an hour of time up or down the page.

5. Place a dot on the line representing Greenwich noon at the proper point to indicate the minutes and seconds of declination of the sun at Greenwich noon of the proper day, as given in the Ephemeris. This can easily be done within 5 sec.

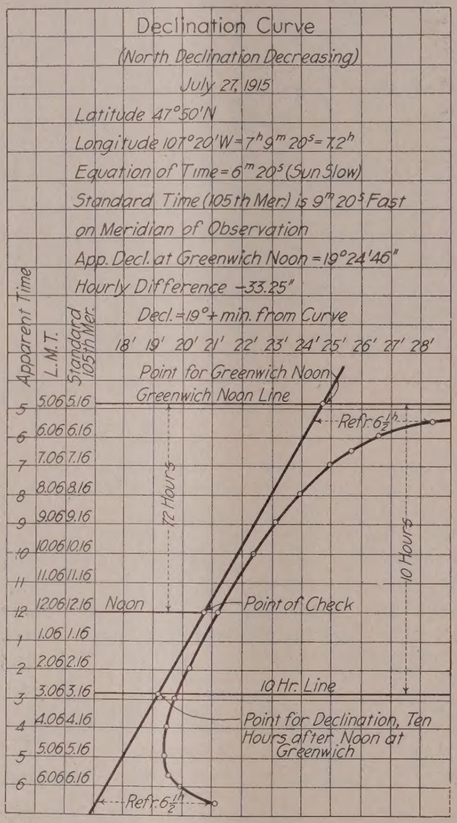
6. From the Greenwich noon line measure 10 hr. down the page, and through the point thus located draw a second horizontal line across the page. For convenience call this the 10-hr. line.

7. Multiply the "hourly difference," given in the Ephemeris, by 10, and reduce the product to minutes and seconds of declination by dividing by 60. If the sun's declination is increasing numerically (either north or south) the declination given for Greenwich noon must be increased by the change for 10 hr. If the declination is decreasing numerically (either north or south) the declination given for Greenwich noon must be decreased by the change for 10 hr. Plot a point for the resulting increased (or decreased) declination at the proper location on the 10-hr. line.

8. Draw a straight line exactly through the two points thus plotted. This line is the graphic representation of the change of declination for the current day, at the rate per hour given by the Ephemeris. For convenience call it the declination line. At the solstices June 22 and Dec. 23 the declination line stands nearly vertical. (At all other times it slants downward to the left if the declination figures are written to progress from right to left.)

9. Take from the table of refractions in declination the proper quantities for 0 hr. (12 m.), 2 hr., 3 hr., 4 hr., 5 hr., 5½ hr. and 6 hr., for the proper latitude and size of the declination angle, north or south, as the case may be. Interpolation becomes necessary only if an error of 5 sec. or more would otherwise result. Mark on the straight edge of a slip of paper a little scale of these refractions, drawn to the scale of the 1-min. spaces between the vertical lines on the page.

From the declination line scale off along each hour line (except 11 and 1) the appropriate distance representing the refraction for that hour. When the sun's motion in declination is northerly (December to June) these measurements must be laid off to the left of the declination line. Conversely, from the summer solstice to the winter solstice the refractions are plotted to the right of the declination line. No inconvenience in plotting is encountered at the equinoxes.



THIS SAMPLE PAGE SHOWS METHOD FOR OBTAINING DECLINATION CURVE

Sketch a curve through the resulting series of points. This curve indicates, by its intersections with the hour lines, for any (apparent) time of day, the proper quantity to be set off on the declination arc of the solar attachment.

10. Check is obtained by adding to (or deducting from) the declination for Greenwich noon the change of declination occurring between Greenwich and the local meridian, which is obtained by multiplying the hourly difference by the hours and decimal used in locating the Greenwich noon line. The result should check, within 5 sec. or less, the declination value of the point at which the declination line intersects the noon line.

11. Meridian observations with the solar attachment must be made by apparent solar time, while the observer's watch is ordinarily set to standard time. Hence it will be found very convenient to prepare two time columns, the first for apparent time and the second showing the corresponding standard time. Mean local time may also be shown if desired.

It is understood that this method was devised by Arthur M. Kidder, supervisor of surveys, General Land Office.

Court Forbids River Pollution by Filter Wash-Water

Municipal Plant at Niagara Falls Must Divert Waste Effluent from Intake of Competing Private Company

BASING his decision upon the established rule that while riparian owners do not own the water each is entitled to a reasonable use thereof, Judge Laughlin of the New York State Supreme Court, in the case of the Western New York Water Company vs. City of Niagara Falls, enjoined the municipal filtration plant, on July 5, from discharging its wash-water and sedimentation basin sludge into the Niagara River at a point above the intake of the private water company, whose supply, it was contended, was unduly polluted by this practice. The two plants compete in the business of supplying filtered water to the inhabitants of the city, and in some quarters credence was given to the rumor that the suit was merely one evidence of the ill feeling which rivalry between the city-owned and the privately-owned works had engendered. It was claimed by the defendants that the action was brought for the purpose of coercing the city into purchasing the plaintiff's plant and franchise, but Judge Laughlin found nothing to warrant the belief that the plaintiff had brought the action for an ulterior purpose, or that either party was acting in bad faith. For the Western New York Water Company H. F. Huy of Buffalo, James M. Caird of Troy, and his assistant, F. J. Longley, testified as experts.

QUANTITY OF SEDIMENT DISCHARGED

The city plant, described in the Engineering Record of June 1, 1912, page 601, takes water from the river at a point 2 miles above the plaintiff's intake. The evidence showed that the wash-water discharge from the municipal works amounted, in 1914, to 95,176,800 gal. or an average of 260,000 gal. daily, and that the average amount of suspended matter, not including solids in solution, in this effluent from the filter beds was from 4.56 to 8.9 tons per 1,000,000 gal. The defendant also discharges into the river from ten to twelve times per annum about 1,000,000 gal., the contents of each of two sedimentation basins connected with its filtration plant, consisting of bacteria and other impurities separated from the raw water, together with the chemicals added thereto by the defendants. The average amount of suspended matter, not including solids in solution, in this discharge is about 23 tons per 1,000,000 gal. From the sedimentation basins alone there is probably discharged into the river annually approximately 550 tons of suspended matter. About 300 tons of aluminum sulphate are added to the water annually in the coagulating basins and in the effluent discharged into the river. It thus appears that about 5/6 ton of chemical matter is discharged into the river daily on an average by the defendants in the operation of its filtration plant.

The currents of the river from the point of this discharge to the plaintiff's intake are toward or along the bank, and the flow of the current is about 1 mile per hour. The average amount of suspended matter in the water at the plaintiff's intake is from 0.4 to 0.5 ton per 1,000,000 gal.

It is true, the Court states, that with the exception of the chemicals all of the impurities in the effluent have been taken from the river, but they have been taken so far from the bank that it is fairly to be inferred that none of them would have entered the intake of the plaintiff. Moreover, they are discharged in concentrated form. The waters of the river are otherwise largely polluted, both above and below the filtration plant of the defendants, and it is impossible to determine with any degree of definiteness the proportion of the entire pollution caused by the defendants, but it is fairly to be inferred that some of the pollution of the water from which plaintiff takes its supply is caused by this discharge of effluent from the filtration plant of the defendants. There is a trunk sewer in Buffalo Avenue adjacent to the filtration plant of the defendants, into which the effluent from the filtration plant could be discharged as conveniently and with no greater expense than into the river.

DAMAGES INDETERMINABLE

The acts of the defendants, according to Judge Laughlin, are in the nature of continuing trespasses for which an action at law does not afford an adequate remedy, and while ordinarily equity does not intervene to prevent the infliction of merely nominal damages, that rule does not apply to the case at bar for the reason that in such case nominal damages are deemed substantial. Moreover, it is evident that there are substantial damages, but it is impossible to show them with a sufficient degree of certainty to warrant a recovery. It is not even essential to the maintenance of an action for pollution that damages shall have been suffered if the plaintiff's rights have been invaded and there is danger that such invasion may ripen into a prescriptive right, as there is in the case at bar.

The Court further states: "There is no force in the contention that the action cannot be sustained without joining all parties who are contributing to the pollution of the river, and that since the water is so polluted by others that even if the discharge of the waste effluent from the filtration plant of the defendants were stopped, still the plaintiff would be required to filter the water, as doubtless it would. If the plaintiff were seeking to recover damages the extent of the pollution by others would have a material bearing, for defendants would only be liable for the damages caused by themselves; but otherwise these contentions have been frequently made in principle and overruled.

"The city of Niagara Falls is rapidly increasing in population, and the contamination of the river by this effluent from the filtration plant of the defendants will naturally be more and more. Without, therefore, expressing an opinion with respect to the right of the plaintiff to injunctive relief against others who are polluting the waters of the river, it is, I think, proper that a court of equity should enjoin a municipality, which is engaged itself in supplying part of its inhabitants with water, from unnecessarily contaminating and polluting the water from which the plaintiff takes its supply for others of the inhabitants of the city, and especially since it is evident that another outlet for the effluent from the filtration plant is available at a very small expenditure. The defendants, however, should have a reasonable time to enable them to construct another outlet."

Judgment, accordingly, has been entered enjoining defendants during the continuance of plaintiff's leasehold and franchise rights from discharging the effluent from their filtration plant into the Niagara River, but with the provision to the effect that it shall be suspended for the period of six months to enable the defendants to provide another outlet, and with leave to defendants to apply at special term, if necessary, for an extension of such period of suspension if for insufficiency of appropriation of funds or other cause they shall require further time.

Business Principles in Constructing Public Buildings

Secretary of the Treasury Issues Orders That Grade Buildings in Accordance with Business Transacted Therein

THE Secretary of the Treasury, Mr. McAdoo, has issued an order to the Supervising Architect's Office, putting into force his policy with reference to the construction of post-office and Federal buildings. The new order seeks to establish a rational system of uniformity and business economy in the construction of Government buildings and to get away from the "pork-barrel" system. The Secretary proposes hereafter to construct in a locality such a building as local conditions and the present and future needs of the service demand, and not to be governed entirely by the size of the appropriation.

For the past two years the Treasury Department has been following the same general business policy in the purchase of post-office sites. The Public Buildings Act of March 4, 1913, authorized the purchase of 303 sites in various parts of the country. To date only 136 have been acquired, but these have been bought for $571,775 less than the amount Congress authorized to be paid.

The Secrtary designates four different classes, depending upon the amount of business transacted, as follows:

CLASSES A AND B

Class A.—For post offices of the first class with annual receipts of $800,000 or over: Marble or granite facing; fireproof throughout; metal frames, sash and doors; interior finish to include the finer grades of marble, ornamental bronze work, mahogany, etc. Public spaces to have monumental treatment, mural decorations; special interior lighting fixtures.

Class B.—Post offices of the first class with receipts from $60,000 to $800,000: Limestone or sandstone facing; fireproof throughout; exterior frames and sash metal; interior frames, sash and doors wood; interior finish to exclude the more expensive woods and marbles; ornamental metal to be used only where iron is suitable; restricted ornament in public places.

CLASSES C AND D

Class C.—For post offices of the second class with receipts of $15,000 or over, and of the first class up to $60,000: Brick facing with stone or terra cotta trimmings; fireproof floors; non-fireproof roof; frames, sash and doors wood; interior finish to exclude the more expensive wood and marble; the latter used only where sanitary conditions demand; public spaces restricted to very simple forms of ornament.

Class D.—For post offices having annual receipts of less than $15,000. Brick facing, little stone or terra cotta used; only first floor fireproof; stock sash, frames, doors, etc., where advisable; ordinary class of building such as any business man would consider a reasonable investment in a small town.

GENERAL CONSIDERATIONS

Closing his order, the Secretary says:

"Wherever local conditions permit, labor and time should be saved in the design of building by utilizing plans of buildings hitherto constructed, provided the foregoing conditions are observed.

"Work on the standardization of full-sized details should be carried forward as rapidly as possible; and similar attention should be given to the completion of the work that has been undertaken in preparing standard specifications. The completion of these features should result in considerable saving in time in getting buildings under contract.

"In the preparation of specifications special consideration should be given to such changes as may be practicable to shorten the contract time.

"While I recognize the fact that frequently strong sentiment is expressed in favor of the use of local material in the construction of public buildings, I do not feel justified in limiting competition to such materials, or in awarding contracts for material so produced at prices which amount to subsidizing local industries. Bids should not be solicited specifically for local materials, but should be taken under such conditions as will insure the widest possible competition for the class of materials called for."

Columbus Experts Determine B. Coli Vagaries

Testing Methods and Relative Counts for Various Stages of the Purified Waters Compared for a Two-Year Period

COMPARATIVE presumptive B. coli tests were made for two years at the Columbus water purification works for the purpose of ascertaining the relative importance of the various methods in use when applied to the water as it passes through the different steps from the river to the final effluent. Russel D. Scott, assistant bacteriologist, in the June *Ohio Public Health Journal*, gives the results in detail. His conclusions are as follows:

1. The bacteriological character of the Scioto River water during periods of long storage varies from that during flood stages in that: (a) The number of bacteria is much less. (b) The 37 deg. agar count is a much higher proportion of the 20 deg. count. (c) Of the B. coli group, the saccharose-fermenting type are the most numerous.

2. The lime softened water varies bacteriologically from the raw water in that: (a) The number of bacteria is much less. (b) The ratio of the number of B. coli to the total number of bacteria is less. (c) The saccharose-fermenting types of B. coli are much more numerous. (d) The proportion of dextrose fermenters which do not ferment lactose is much greater. (e) The ratio of the 37 deg. to the 20 deg. count is

greater. (f) The ratio of the gelatine to the agar count is very much higher.

3. The proportion of organisms not fermenting dulcite is not affected either by storage or by lime treatment. This is also true of those which do not form indol.

4. The members of the B. coli group form somewhat less than 4 per cent of the total number of bacteria at 37 deg. C. This ratio is, however, quite irregular.

5. The proportion of organisms in the river water which ferment dextrose but not lactose is not affected by storage.

Life of Wood Pipe

D. C. Henny, Consulting Engineer of the U. S. Reclamation Service, Summarizes His Experience and Studies

IN the August number of the "Reclamation Record" there appears a report on the life of wood pipe made by D. C. Henny, consulting engineer of the U. S. Reclamation Service. It is based in part on his personal experience and observation, but more largely on data supplied to him by owners and managers of plants and projects using this type of conduit. In the report itself are long tables giving data on individual lines. These are omitted here. The lines listed used principally redwood and fir. Both wood-stave and bored wood pipe were investigated. Mr. Henny's conclusions relate only to the timber portion of the pipe and not to the bands.

Mr. Henny's report is, in part, as follows:

WOOD USED

The term "Fir" is applied to the most common wood of the Pacific Northwest. Scientifically it is a bastard spruce, first named by Douglas. Locally it is known as fir or Douglas fir, and distinction is sometimes made between yellow and red fir. These come from the same kind of tree, the yellow fir being most common. The large trees yield yellow fir, while the wood from smaller trees is apt to show a reddish tint. Sun exposure also appears to affect the color to some extent. In California the wood is termed Oregon pine. This wood is strong, and can be obtained in long lengths. Mill run of commercial sizes probably averages over 20 ft. in length. It contains pitch, which forms in seams and pockets, normally occurring even in commercially clear wood within certain limits. The trees usually yield less than 25 per cent of wood free from sap and knots. The expense of eliminating these defects has led to the practice, as regards pipe construction, of permitting some small and sound knots and sap.

Redwood grows on the Pacific coast from Santa Cruz north into southern Oregon. By reason of the average large diameter of the trees, the logs are cut shorter than in the case of fir, and the commercial mill run averages about 16 ft. in length. The wood is not as strong as fir. About 50 per cent of the wood cuts up clear and free of sap, which has led to the custom of demanding freedom from knots and sap in ordinary pipe specifications.

TYPES OF PIPE

Continuous stave pipe consists of staves breaking joint and clamped together with bands, which since 1888 have universally been made up of steel bolts and lugs, the latter being made of cast iron, malleable iron, or pressed steel. The butt joints are made tight by a metal or wooden plate.

Wire-wound or machine-banded pipe is pipe made up in sections from 10 to 24 ft. in length. It consists of staves held together by galvanized wire, spirally wound around the pipe under heavy tension. The wood is usually kiln dried, which is not the case with continuous stave pipe. The ends of each section are machine turned to an exact diameter, sometimes slightly tapered. Sections are united by some form of sleeve, a sleeve made up of staves and wound around with wire or individual bands being most common. Light-pressure pipes are often provided with mortise and tenon ends, dispensing with the necessity of sleeves.

DURABILITY

The wood surface in continuous stave pipe is, with a few exceptions, uncoated, while sectional pipe is heavily coated, the coat consisting of asphaltum and tar, with sawdust on the outer skin. The investigation has had in view especially the life of pipe as affected by the durability of the wood.

Reviewing the information as grouped under its headings, it may be estimated that under conditions of continuous water pressure the life of various kinds of pipe may be as follows:

LIFE OF THE WOOD IN WOOD PIPE LINES

Wood	Condition	Years
Fir.......	Uncoated, buried in tight soil...	20
"	Uncoated, buried in loose soil...	4-7
"	Uncoated, in air..............	12-20
Redwood..	Uncoated, buried in tight soil, loam or sand, and gravel....	Over 25
Fir.......	Well coated, buried in tight soil.	25
"	Well coated, buried in loose soil.	15-20

Under conditions interfering with complete saturation of the wood, the life is cut down materially. These conditions are in the case of uncoated pipe brought about by open-soil and low-water pressure. The effect of coating appears to be equivalent to tight soil cover, with possibly the additional advantage of tar in the coating acting as a disinfectant. The effect of unfavorable conditions as to lack of complete saturation is serious in redwood, resulting in a life which may be shorter than 15 years, but is much more marked in fir, where it may be as low, in spite of coating, as six years.

FACTORS IN DURABILITY

It is quite possible that the life of individual pipe is not merely affected by surrounding conditions, but may have been shortened by the quality of the individual pieces or the treatment of the wood. The wood from the bottom of a tree is close grained and likely to last longer than from the top of the tree, even though free from sap.

Bastard staves, especially in fir, resist penetration of the water in the pipe to a greater extent than diagonal grained or vertical grained wood and may show a shorter life. Again, too, rapid kiln drying, which may at times have been practised on lumber from which staves for wire-wound pipe were run, may have partially destroyed the vitality of the wood. It has not been practicable to differentiate between the causes which in this manner may have shortened the life of the wood in pipe, nor to ascertain what has been the effect of permitting some sap in the wood from which decay may have spread to the adjoining sound wood. Unquestionably much wire-wound pipe has been manufactured without being subjected to strict supervision and inspection.

CONCLUSIONS

On the whole the following conclusions seem justified as regards the relative life of fir and redwood in pipe:

1. Under favorable conditions of complete saturation fir well coated may have the same life as redwood uncoated.

2. Either kind of pipe will have a longer life if well buried in tight soil than if exposed to the atmosphere. Such life may be very long, 30 yr. and over, if a high, steady pressure is maintained.

3. Either kind of pipe will have a longer life if exposed to the atmosphere than if buried in open soil, such as sand and gravel and volcanic ash, provided in hot and dry climate it be shaded from the sun.

4. Under questionable conditions, such as light pressure or partially filled pipe, fir, even if well coated, may have only from one-third to one-half the life of redwood.

5. Under light pressure the use of bastard staves in fir pipe should be avoided.

6. The use of wooden sleeves in connection with wire-wound pipe is objectionable and has caused endless trouble and expense. It is possible that the objection may be partially overcome by dipping ends of sleeves in creosote and by applying a heavy coating of tar to the ends of the sleeves. Saturation of sleeve wood will never be as perfect, however, as of the straight pipe, and full creosote treatment of the wood or else some form of metal sleeve, either riveted iron or steel heavily coated, or cast iron will probably be well worth its extra cost.

7. If wooden sleeves are employed, they should be provided at least for sizes from 10 in. up with individual bands to permit taking up leaks.

PITCH AND KNOTS

Pitch seams do not occur in redwood. In fir they should be distinctly limited as to size, frequency and depth. In respect to knots, there appears to be no reason for making any distinction between the two classes of wood. Small, sound knots, if not passing through the full thickness and not occurring close to edges or ends might be permitted in either wood. Sap is objectionable, and the higher cost in prohibiting it entirely or of putting narrow limitations on it is probably justified in both fir and redwood.

Wooden pipe is not suitable in cases where it can not be kept full and under pressure during periods of use. Coating cannot under such condition be expected to afford protection against decay. Coating should be continuous and heavy, not less than 1/16 in. to be fully effective, and should preferably consist of more than one individual coat of a mixture of asphaltum and tar, or of an application of gas tar followed by one or more applications of refined coal tar. Little experience, however, can be quoted in support of all-tar coating.

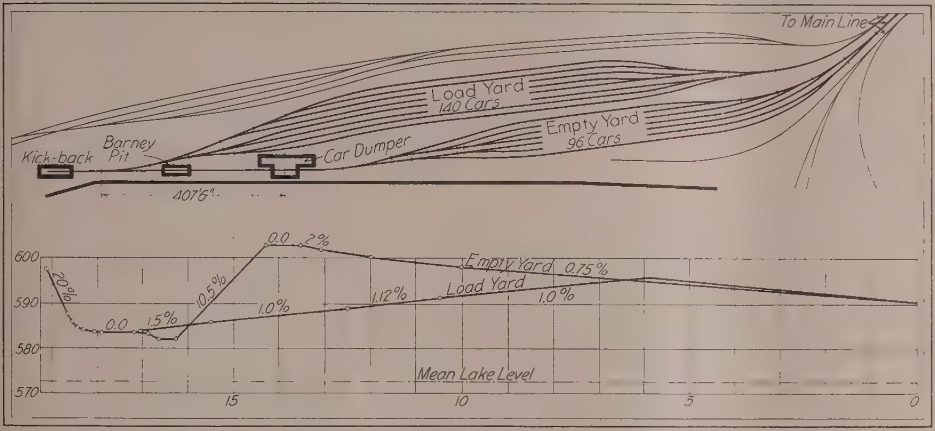
All tentative conclusions herein presented are necessarily based on the limited data which could be collected and will undoubtedly require amendment as further experience accumulates.

THE TYPICAL BASEMENT COLUMN of the Woolworth Building in New York City has a cross-sectional area thirty-six times that of the roof column.

New Coal-Handling Plant at Toledo Was Built Entirely During Winter

When Navigation Opened This Spring Users of Cincinnati, Hamilton & Dayton Facilities Found Improved Car Dumper and Layout on Site of Old

WITH THE OPENING of navigation on the Great Lakes, the Cincinnati, Hamilton & Dayton Railway placed in operation at Toledo, its principal port on Lake Erie, a modern coal-handling plant, dock and yard to facilitate the handling of traffic and provide for the steady growth of this business during recent years. The new facilities are situated on the Maumee River, at Rossford, and provide Toledo with one of the most modern terminals of the kind on the Great Lakes. The improvement was made entirely during the winter, when lake navigation was closed, work not being started until December of last year.



PLAN AND PROFILE OF LAYOUT—CARS MOVE ENTIRELY BY GRAVITY EXCEPT UP SHORT BARNEY INCLINE

The yard plan is shown. The terminal is laid out so that adjacent to the unloading machine is a yard with a capacity of 236 cars, and in this yard 140 loaded cars and 96 empties can be handled. To the south of the dock is a classification yard with a capacity of 3000 cars, affording ample space for assembling shipments.

The plans as prepared called for the construction of 802 ft. of concrete dock, the necessary foundations for the machine, the entire reconstruction of the load and empty yards and the fabrication and erection of the new mechanical car dumper with the necessary approach and run-off trestles.

Details of the concrete dock construction are shown. This type of dock was placed on both sides of the machine foundation. The dock immediately in front of the machine is of the same general construction, except that the batter piles were omitted, and the dock was made a part of the machine foundation, this foundation being of pile construction, capped with a reinforced-concrete slab, to which the dock is anchored.

CAR DUMPER

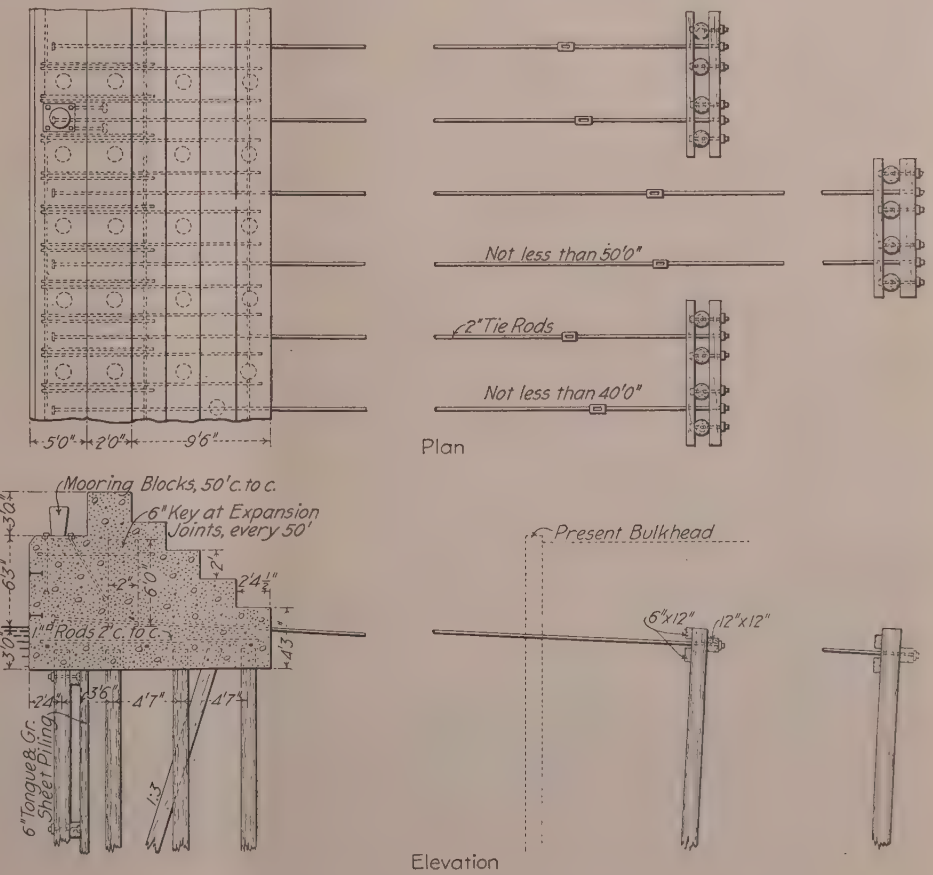
The car dumper is designed to handle cars of a maximum gross weight of 280,000 lb., and the clearance length of the machine is 53 ft., which will permit handling cars 52 ft. long over couplers. The machine is of the latest steam-operated type, with counterweighted cradle, the steam being furnished by two Scotch boilers, each with a capacity of 250 hp. It is designed to handle forty 100-ton cars per hour. The cradle rail is 30 ft. above the lake level, which is considerably higher than normally adopted for installations of this kind; the adoption of this elevation was due to the desire to reduce the amount of lift of cars in the machine to a minimum.

A disappearing barney was provided, which makes it possible to run a car over the barney pit from the load prior to the return of the barney from the delivery of a car to the machine. This is accomplished by means of by-pass gates in the barney track, which are operated by the steam cylinder, which controls the reversing mechanism of the haulage engine. The barney returning from the machine passes into the barney pit on the by-pass gate nearest the machine, and thence runs under the car to the end of the pit. The reversing of the haulage engine raises both by-pass gates, so that the barney in returning comes up behind the car by means of the by-pass gate farthest from the machine. This arrangement has the effect of keeping a car up to the machine at all times.

CONSTRUCTION RECORD

Contracts for the foundation and dock work and for the mechanical car dumper were placed about Nov. 1, 1914, and preparations made for actively starting the work at the close of navigation. The old machine was abandoned Dec. 2, 1914, and the dismantling and dock construction started the next day. The piles in front of the old dock were driven by floating equipment, using steam hammers. Those back of the old dock were driven by land drivers. The piles were driven to refusal to a bed of hard pan and small granite boulders, approximately 31 ft. below the lake level. The operation of the floating equipment for driving piles and sheet piling was made possible by using an ice tug, which kept the river ice broken and clear of the site of the work during extremely cold weather.

With the exception of the sand, all of the materials used in the concrete work were brought to the site by rail. The sand was unloaded from boats at the dock site. The mixing plant was located about 1000 ft. south of the machine, where the storage bins were provided and a heating plant for heating all material was installed. The concrete was transferred from the mixing plant to the site of the work in drop-bottom buckets on flat cars, by means of narrow-gage equipment. The concrete was placed continuously and without reference to the weather conditions. This was made possible by having the materials as mixed prop-



DETAILS OF NEW CONCRETE BULKHEAD LOCATED OUTSIDE OF OLD ONE

THIS COAL-HANDLING PLANT WAS BUILT ON SITE OF OLD ONE BETWEEN CLOSING AND RE-OPENING OF NAVIGATION

erly heated, and, after concrete was deposited, keeping it warm by means of the steam plant located at the machine foundation. Some of the concrete was placed with temperatures as low as —12 deg. Fahr. with no bad effects.

The machine foundation was completed Feb. 8, 1915. The concrete for the barney-pit construction was completed March 7. The superstructure contractor started operations Feb. 2, and the first steel was raised Feb. 15. The machine was finished, ready for the preliminary test of the cradle on April 9, and the entire machine was completed, ready for operation, April 12.

During the progress of the construction of the concrete docks, machine foundation and superstructure, the railroad company's forces reconstructed the yards to the revised alignment and grades, at an elevation of approximately 8 or 9 ft. above the old yards. The reconstruction and raising of the yards was begun Dec. 6, 1914, and the yards were in condition for operation April 12, at the time the machine was completed.

The erection of the approach and run-off trestles was handled by the substructure contractor, the material being framed near the site of the work, transferred to the final location and erected by means of a locomotive crane.

TWO MONTHS OF OPERATION

While the improvement as a whole was ready for operation April 12, 1915, three days prior to the opening of navigation, the machine was not put into active service until April 19, when the first boat was secured. For the two months ended June 19, the machine handled 10,439 cars, or 469,064 tons of coal. The two months' period has developed the fact that the machine and yard are capable of handling the coal as fast as anticipated. In one day's run of ten hours 340 cars were handled, with a total tonnage of 16,393. There were also handled in one day's run of twelve hours 405 cars; these runs involved the handling of from 45 to 49 cars per hour for short periods.

Smith-McCormick Company, of Easton, Pa., was the contractor for the substructure and approach trestles; J. C. Carlin of Toledo furnished the greater portion of the filling material, the Pittsburgh Construction Company of Pittsburgh was the contractor for dismantling the old machine, and the Wellman-Seaver-Morgan Company of Cleveland furnished the new car dumper. The design and construction of this plant were under the direction of F. L. Stuart, chief engineer of the railroad, and the work was prosecuted under the supervision of A. M. Kinsman, engineer of construction; W. S. Bouton, engineer of bridges; A. H. Griffith, assistant engineer, and P. Callahan, resident engineer.

Reinforced-Concrete Arch Bridge Has Stone Facing

Three Flat-Arch Spans and Low Piers for 300-Foot Crossing at South Bend, Indiana, Completed at Total Cost of $101,500

THE BRIDGE recently completed at South Bend, Ind., across the St. Joseph River from Leeper Park on the south side to the north shore drive was designed with special attention to external appearance, because of its location. Bedford stone, smooth finished and laid in non-staining cement mortar, was used for facing the entire bridge and for the handrail. An elliptical curve was adopted for each of the three arch spans of small rise, and the resulting outlines, as shown by the accompanying photograph, give a very satisfactory appearance. Work was begun on this bridge Aug. 20, 1914, and just about five months later street-car tracks were laid and practically all of the construction except sidewalks and paving had been completed.

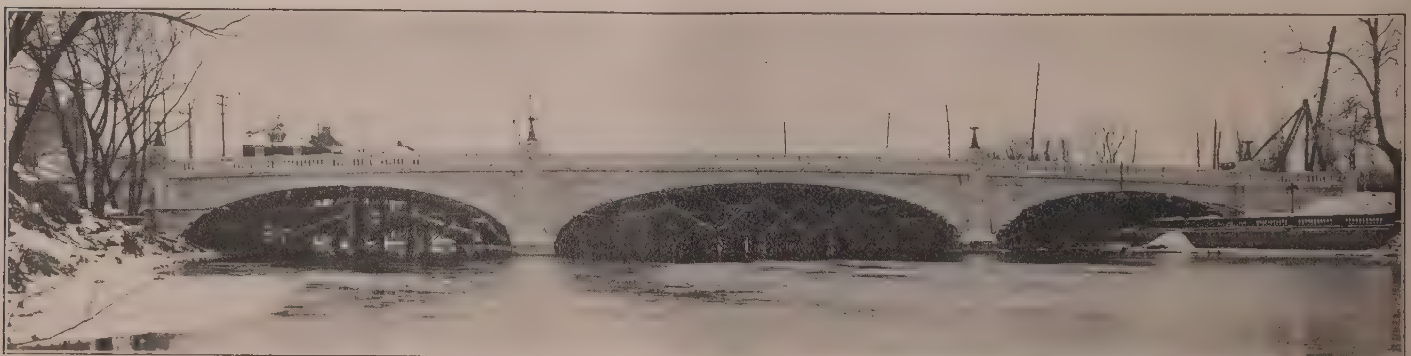
The structure is 300 ft. long and 70 ft. wide between spandrel walls and contains approximately 7000 cu. yd. of concrete. The foundation soil consisted of sand, gravel, clay and quicksand in the various locations, hence it was necessary to drive piles from 25 to 35 ft. long about 4 ft. on centers under all piers and abutments. In order to eliminate any danger from washing out of the quicksand at the foundation of the south pier, the 18-ft. steel sheet piling used for the cofferdam was driven down to a point 12 ft. below the footing.

DETAILS OF ARCHES AND PIERS

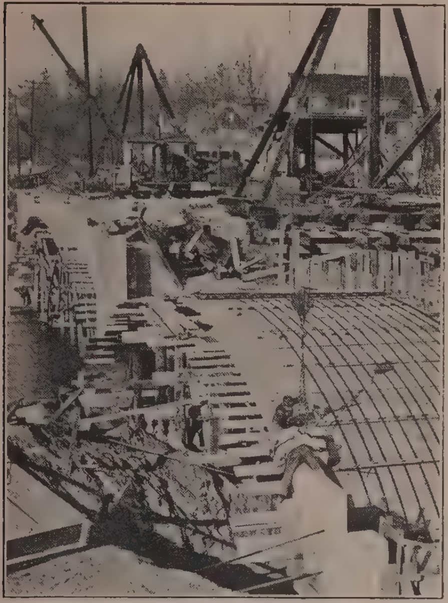
The center arch has a clear opening of 116 ft. and a rise of 16 ft. 8 in., or about one-seventh of the span; the two side arches are 80 ft. clear span and about 14½ ft. rise. The flatness of these arches was decreased by using a roadway grade line on a vertical curve with a rise of 4 ft. at the center of the bridge. The piers are 12 ft. wide and 87 ft. long, and extend 16 ft. below the springing lines of the arches. They were designed to withstand the unbalanced load on the longer arch, by making the footing 6 ft. wider on the side opposite the large arch.

The solid arch ring of the 116-ft. span is 2 ft. 4 in. thick at the crown, 4 ft. at the haunches, and 8 ft. 6 in. at the piers; the arch rings for the 80-ft. side spans are 1 ft. 10 in. thick at the crown, 3 ft. 3 in. at the haunches, and 6 ft. 6 in. at the abutments. These arch rings are reinforced at both intrados and extrados with deformed bars spaced 12 in. on centers and extending well into the piers and abutments. Lacing bars of ½-in. rods connect the main bars, which are also tied together by ½-in. rods running at right angles to them and spaced about 4 ft. apart.

The spandrel walls were built of concrete



BEDFORD STONE WAS USED TO FACE THE CONCRETE BRIDGE OVER THE ST. JOSEPH RIVER, AT SOUTH BEND



STONE FACING BEING SET PRIOR TO CONCRETING OF ARCH RING

reinforced with 7/8-in. bars and placed behind the Bedford stone facing already mentioned. As indicated by the accompanying photograph, the stone was used for the face form behind which the concrete was placed. After the stones were laid up they were coated on the back with a heavy coat of water-proofing, including a second coat of asphaltic paint, special care being used at the joints. The same treatment was given to the back of the arch rings and the spandrel walls, and no discoloring whatever has developed.

Loads, Materials and Costs

The arch rings were designed for a live load of 300 lb. per square foot over approximately one-half of the span; the line of pressure for this loading was found by the elastic theory to lie within the middle third of the joints for the entire arch. The dead load was assumed at 150 lb. per cubic foot for concrete, 100 lb. per cubic foot for earth fill and 100 lb. per square foot for the pavement. Concrete, composed of a 1:2½:4 mixture of Portland cement, washed sand and crushed stone, was used for the arch rings, and for the piers, abutments and spandrel walls the proportions were 1:3:5.

The contract price for the bridge, including the pavement and ornamental cast-iron lighting poles, was $93,663. For extras there was charged 40 cents per linear foot for piling, $2.50 per cubic yard for wet excavation, and $6 per cubic yard for concrete, bringing the final total cost to about $101,470, including the cost of the steel sheet piling left around the south pier.

Credit for the early completion of the work is due to the contractors, the Cleary Kuert Company of Indianapolis, who furnished a well-equipped plant and maintained a good organization, with A. Bessinger as resident engineer.

The bridge was designed and constructed under the supervision of Charles W. Cole, civil engineer, Mishawaka, Ind., from whom the foregoing data and photographs were obtained.

THE PRODUCTION OF MANGANESE ORES in the United States in 1914 amounted to 2635 long tons, which was 1413 tons less than the output of 1913, according to D. F. Hewitt of the U. S. Geological Survey.

Concrete Cribs Used Successfully in Dock Construction at Victoria

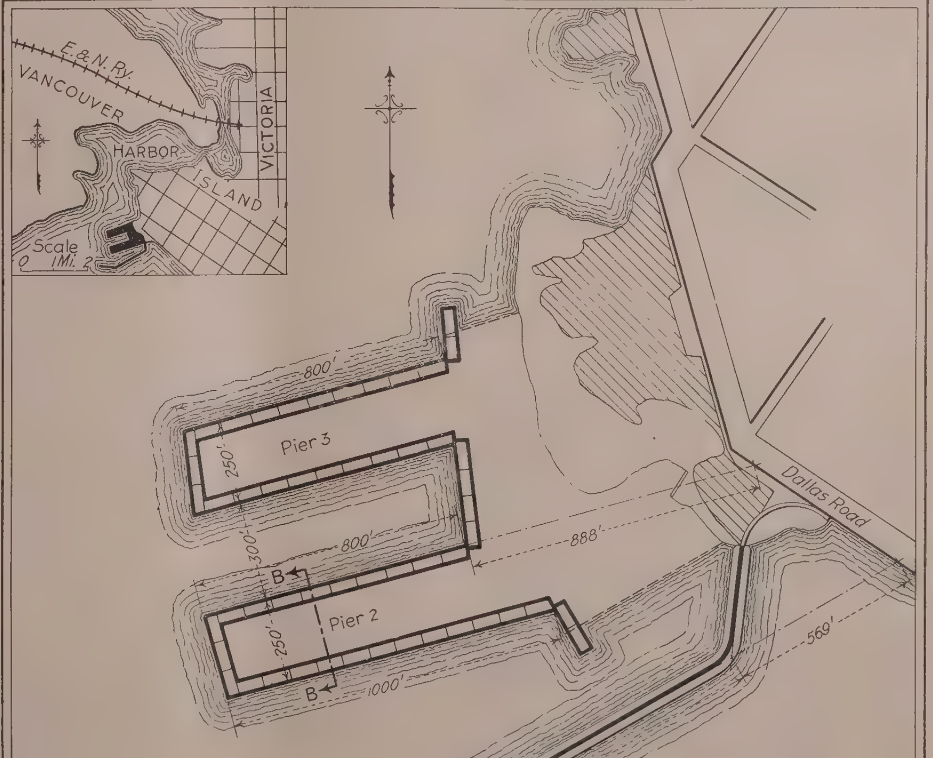
Cribs Placed Without the Aid of Diver After Foundation Rock Was Dumped from Tilting Scows and Leveled by a Plow

HARBOR DEVELOPMENT on an extensive scale is now well under way at Victoria, B. C., under the supervision of the Department of Public Works of Canada. The first units in the work are a 2500-ft. breakwater and two large docks in the outer harbor, all these being constructed with rubble-mound foundations and reinforced-concrete superstructures. The breakwater is expected to shelter a 90-acre area, and the two docks are being constructed close to it inside the sheltered area with the idea of adding more docks later as the traffic increases. These docks have berthing spaces from 800 to 1000 ft. long and are intended only for the largest vessels; smaller craft will continue to use the inner harbor, reached by a short but narrow and tortuous channel. The improvement of this channel is now under way, and when completed the corners will have been removed as far as feasible and a uniform low-water depth of 20 ft. will be maintained, so that vessels of from 3000 to 4000 tons displacement will have safe access to the inner harbor.

Breakwater

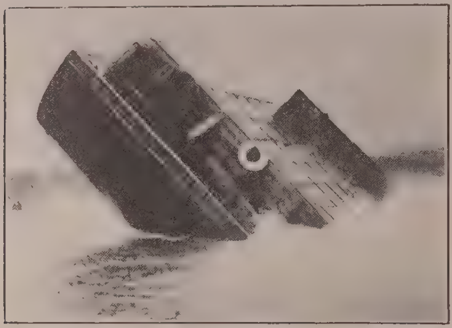
The breakwater consists of a rubble-mound foundation, surmounted by a superstructure of granite blocks on the sea side protecting a concrete superstructure built on the center line. The central part of the foundation consists of a fine quarry run built up to a depth of 35 ft. below low water, with both sides on a 1:1 slope. Larger rock, ranging in weight up to 16 tons per unit, is then dumped from scows until the quarry-run core is covered to a depth of 15 or 20 ft. below low-water level, and the base of the foundation has been brought out to a width of 115 ft. At this 20-ft. level, on the sea side, divers lay granite blocks, of not less than 5 tons weight, on a prepared bed 40 ft. wide at the base. The divers place the usual backing after each course of granite blocks is laid until low water is reached, when the work is advanced by ordinary methods.

In placing the concrete superstructure of the breakwater care is necessary in utilizing the lowest tides so as to minimize the detrimental action of lowering concrete through water. To facilitate this work the concrete is being placed in forms built up in sections about 26 x 20 ft. in area, and 7 ft. high, three sections making up the total height of 21 ft. To prevent currents from disturbing the concrete, a lining of jute tarpaulin is placed all over the bottom and 2 ft. high along the sides of the sections. Each section is built on land and placed in proper alignment by a 10-ton crane, after which the concrete is poured. In order to reduce the danger from settlement of the rubble foundation, a layer of tar felt is placed between adjoining sections.



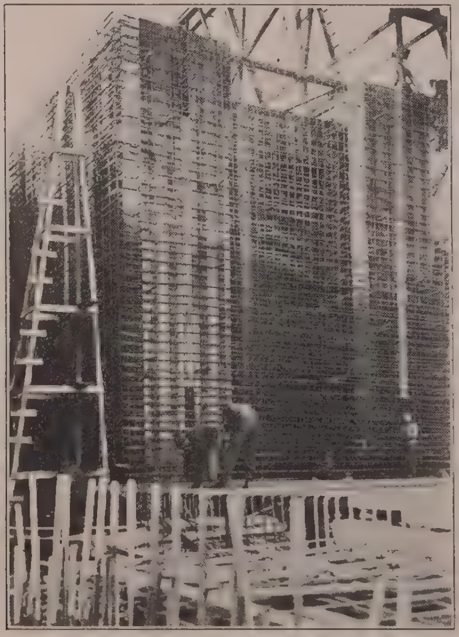
GENERAL ARRANGEMENT OF BREAKWATER AND PIERS AT VICTORIA

The rubble foundations of the docks are placed in a manner similar to that used on the breakwater. A row of piles is driven 12 ft. from the front and back faces of each wall, to be used as guides, and all material is dumped from scows. To carry out the plan adopted by the contractors, there must be no rock projecting above 36 ft. below low water. Any rock that so projects is removed by a clamshell or orange-peel dredge, so as to insure a clearance at this level. The top of the foundation then presents a rough and uneven surface, and this is leveled up to a height of 35 ft. below low water, by means of the clam shell spreading fine gravel. This leaves the foundation in shape for the use of the most novel feature of the construction work, which is a submarine plow, designed to scrape off the foundation and make it sufficiently level to form a satisfactory bed for the cribs, which are floated to place and sunk.



FIRST CONCRETE CRIB PLUNGING TO SITE, 3 MILES OFF SHORE

The plow is a thoroughly braced timber structure, with its forward end pointed and sheeted with iron. The frame is weighted by rock cribs placed at the corners, and is suspended by vertical rods from two horizontal beams, which move on trunnions resting on horizontal walings attached to the top of a row of piles, the level of the piles being established with reference to low-water mark. On the suspension rods are threads and screws by which vertical adjustment may be made to bring the plow proper to any desired position. When the plow has been adjusted to the proper level it is attached by cable to the engine on a scow which, in turn, is attached to a 10-ton anchor fixed in the foundations ahead. The frame is then drawn forward and performs its function of plowing off the foundation to the required level. It is to be noted that the success of this scheme depends on there being no projecting corners of large rocks in the sub-foundation. It may be said, however, that the foundations for the first two cribs were satisfactorily leveled off, and the alignment of the tops of the two cribs above water gives every indication that the method is successful.

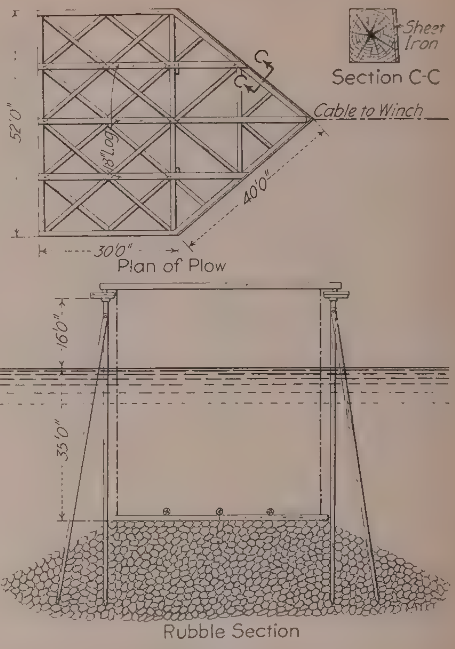


REINFORCEMENT OF CORNER OF CRIB

All the rock dumped from scows had to be accurately measured. A scheme has been developed for doing this at the same time that the work is handled expeditiously. To accomplish this level-decked barges with longitudinal bulkheads are used, in which a watertight compartment along one side is connected to the sea by two 8-in. valves. When the barge is spotted at the proper point these valves are opened, and the inrushing water shifts the center of gravity so that the scow tilts and the load slips off. To facilitate the movement of the rock the deck of the scow has been sheeted with ¼-in. iron plates.

More than a dozen barges of this type are in use, and all of them have been carefully gaged to show the displacement for every ⅛ in. of mean draft. Gages placed at the four corners are read before and after loading, and the weight corresponding to the mean light draft is subtracted from that corresponding to the mean loaded draft to give the net weight of stone. In the case of hopper scows a correction had to be made to allow for the fact that part of the rock is submerged. Assuming 40 per cent for voids, 60 per cent, or three-fifths of the hopper volume, is rock and three-fifths of the hopper displacement has to be added to the apparent weight of the rubble to get the actual weight of rock on the scow. The correction, of course, applies only to the loaded draft, and is added only for gage readings of 3 ft. and more. Readings are taken for every 6 in. of draft, and the displacement for every ⅛ in. is obtained by proportion, a table being drawn up for each individual barge in service.

Building and Placing Cribs

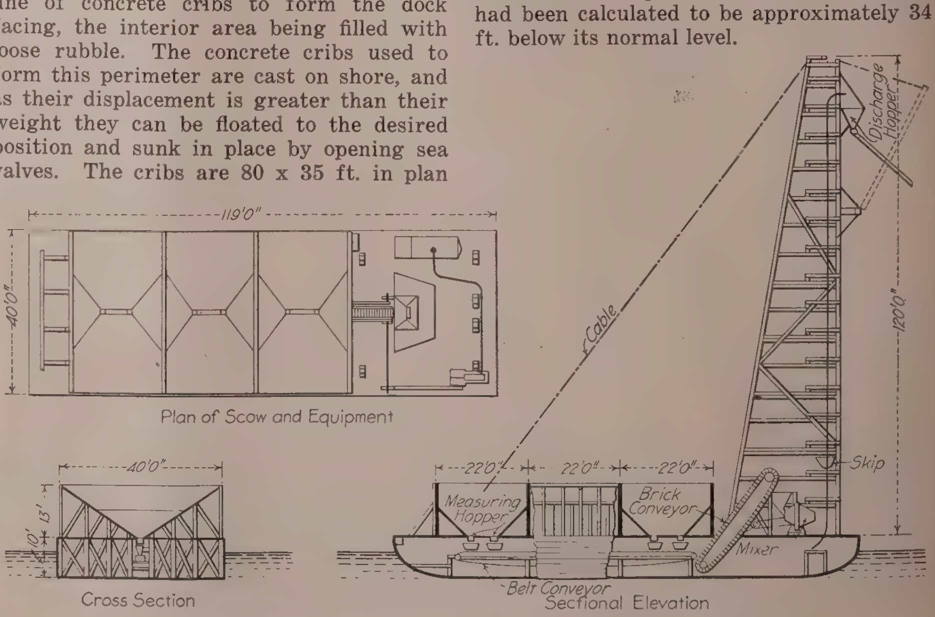


PLOW FOR LEVELING RUBBLE FOUNDATIONS IN PIERS

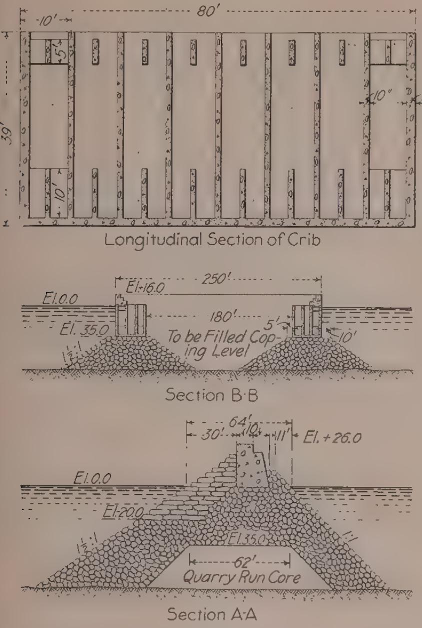
Each of the docks is 250 ft. wide, and around the perimeter it is the plan to place a line of concrete cribs to form the dock facing, the interior area being filled with loose rubble. The concrete cribs used to form this perimeter are cast on shore, and as their displacement is greater than their weight they can be floated to the desired position and sunk in place by opening sea valves. The cribs are 80 x 35 ft. in plan and 39 ft. high. The outer walls are 20 in. thick, with reinforcement sufficient to provide the necessary strength.

The internal bracing of the main outer walls consists of two longitudinal walls and vertical cross walls 10 ft. apart. To distribute uniformly the pressure of the weight of the superstructure built upon the crib, a small party wall is also placed between each main vertical cross wall. When the crib is in position on its foundation, 4 ft. of its vertical face will be visible at low water. A complete superstructure will then be built on the cribs up to the height of the wharf cope level.

The contractors had planned to construct the cribs two at a time on a floating drydock, which had been specially fitted up for the purpose. The drydock was 325 ft. long and 35 ft. high from deck level to tower top. A braced framework 115 ft. high had been constructed to carry an electric crane, which was to be used in placing the molds and reinforcing steel. When the first two cribs were completed the drydock carried a total weight of 6000 tons. It was then to be sunk to a sufficient depth to float the cribs, which had been calculated to be approximately 34 ft. below its normal level.



PLAN, CROSS-SECTION AND ELEVATION OF CONCRETE-MIXING SCOW



CROSS-SECTIONS OF A CRIB AND ITS FOUNDATIONS

A serious accident, however, occurred when the drydock was being sunk, and was described in the Engineering Record of Feb. 20, 1915, page 247. The dock was wrecked, but the cribs remained intact and were eventually refloated and successfully sunk into position on their permanent sites, 3 miles from the point where they were launched. They were found to have a draft of 28 ft. and were sunk in exact position without any further difficulty. Since the accident to the floating drydock, a marine railway has been used for handling the cribs.

HANDLING CONCRETE

Concrete for the cribs is mixed and delivered by a special arrangement which has the advantage of being very compact. The whole apparatus is mounted on a scow 119 ft. long, 40 ft. wide and 10 ft. deep. Three hoppers, two for gravel and one for sand, occupy a length of 68 ft. on the scow, starting at a point 10 ft. from one end. The equipment for mixing and handling the materials occupies a length of 41 ft. at the other end of the scow. The hoppers are the full width of the scow, 22 ft. long and 13 ft. high above the deck. Sand and gravel are discharged from trap doors in the funnel-shaped bottoms into 10-cu. ft. boxes below the deck and between the scow bulkheads. When a measuring box is full the inlet is closed and the material passes out through the bottom to an endless conveyor belt discharging at the forward end of the scow. Here they are delivered into a bucket conveyor, which elevates them to the funnel of the mixer.

The concrete mix for the cribs is 1:2:4 and the mixer charge is proportioned so that one box of sand, two of gravel and five bags of cement are used in each charge. When the proper amount of sand and gravel has been delivered into the mixer funnel, the cement is emptied into an iron vessel in the cement house and blown by compressed air down a 4-in. pipe into the mixer funnel; after which the entire batch is allowed to enter the mixer. After mixing, the concrete is discharged into a skip, hoisted up a tower 120 ft. high, and poured into a funnel, whence it is distributed by pipe to any desired point on the crib.

The work is being carried out by the Department of Public Works, Ottawa, Canada, and J. S. MacLachlan represents the Government as resident engineer in charge.

Net Railroad Revenues Increase

GROSS operating revenues for May on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $1040 per mile, showing a decrease of $7, or 0.8 per cent, as compared with May, 1914. Operating expenses were $732, a decrease of $68, or 8.4 per cent. Net operating revenues, therefore, were $380—an increase of $61, or 24.1 per cent, and operating income was $258—an increase of $63, or 31.9 per cent. It was, however, less than in May, 1913, or May, 1911, and only 3.3 per cent more than in May, 1912. The operating ratio was 70.4 per cent, as compared with 76.3 per cent in 1914, 72.8 per cent in May, 1913, and 71.6 per cent in May, 1912. Considering the three main districts, the respective ratios for May, 1915, and May, 1914, were as follows: Eastern district, 70.0 and 78.0; Southern, 71.4 and 76.1; Western, 70.6 and 74.5.

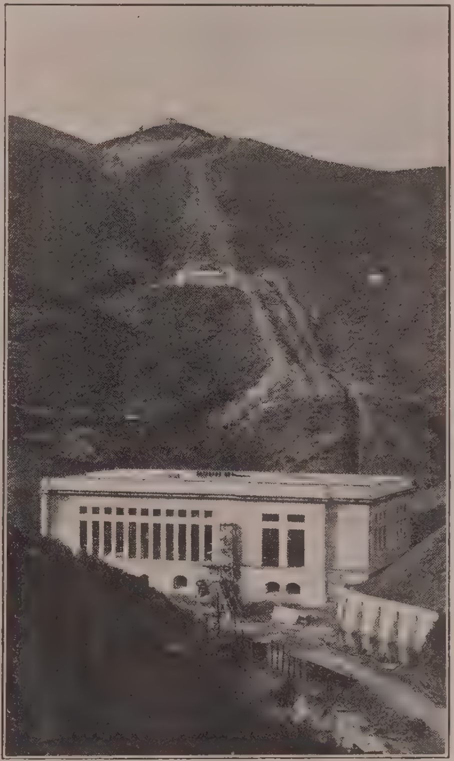
SAN DIEGO CONSUMED 80 gal. of water per capita in 1914—494 gal. per tap—and all of it went through meters. The cost of supplying 1000 gal. figured on total maintenance, was 9.944 cents. The cost to the consumer not a taxpayer was 10.7 cents, to a taxpayer not a consumer 12.4 cents and to a taxpaying consumer 23.1 cents.

SEA SIDE OF BREAKWATER, SHOWING GRANITE AND CONCRETE CONSTRUCTION

Los Angeles Nears Realization of "City Power" Plan

Preparations for Generating Aqueduct Power Facilitated by Validation in June by State Supreme Court of $6,500,000 Bond Issue

THE FIRST hydraulic plant in the chain of stations for developing power on the Los Angeles Aqueduct is nearing completion in San Francisquito Canyon at site No. 1, and the 100,000-volt transmission line which is to convey the current to the city, 47 miles away, will be finished and ready for service in a few months. Work on the power plant will go forward more rapidly, it is reported, since the decision rendered in June by the State Supreme Court validating the $6,500,000 bond issue, of which $1,250,000 was for completing the generating station and transmission line, and $5,250,000 for the acquisition or construction of a distributing system in Los Angeles.

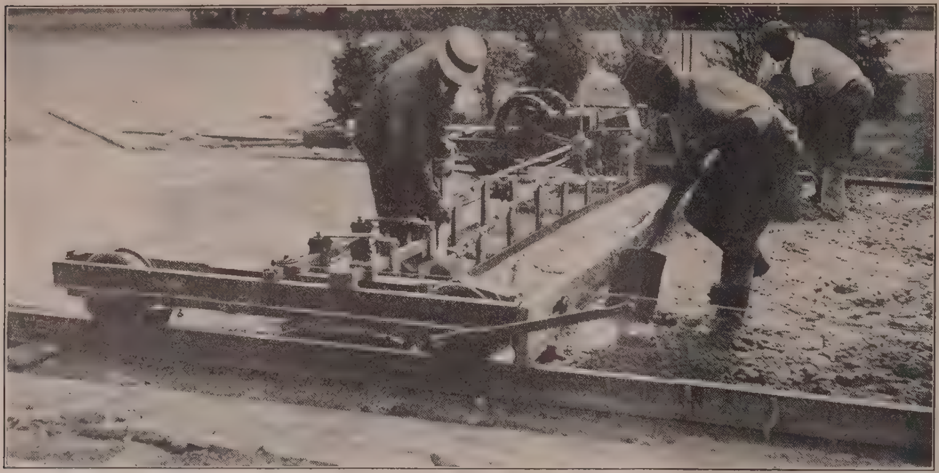


MUNICIPAL HYDROELECTRIC PLANT AT SAN FRANCISQUITO CANYON NEARLY READY TO DELIVER POWER TO LOS ANGELES

STATION CONTAINS SIX UNITS

San Francisquito power plant No. 1 is shown in the accompanying illustration as it appeared on June 25, 1915. The plant is designed for six 7500-kw. units each with a 25-per cent continuous capacity overload. Three of the units are now being installed. The head will vary from 914 ft. under static conditions and zero flow to 814 ft. at the maximum flow of 1000 sec.-ft. Part of the generating machinery is already in place and the pipe for the penstock lines has been delivered.

At the top of the hill near the juncture of the aqueduct proper and the penstock lines is shown part of the elliptical surge tank designed by Prof. W. F. Durand of Leland Stanford, Jr., University, the calculations for which were published in the Engineering Record of July 29 and Aug. 12, 1911, pages 133 and 188 respectively.



POWER-DRIVEN FINISHING MACHINE RUNS ON STEEL SIDE RAILS

Washed Aggregate and Machine-Finished Surface, Features of Michigan Concrete Road

High Quality of Materials Permits Change in Specifications—Comparative Costs on Surface Finishing—Sand and Gravel Washing Adds Little to Cost

WITH its sand and gravel washed on the job, with its surface finished by machine, and with all the latest labor-saving concrete road-building devices, 4¼ miles of Oakland County, Michigan, road, now under construction, is said to be one of the most completely equipped highway undertakings of its kind in the country. The road lies about 10 miles northwest of Detroit, between Royal Oak and Birmingham.

SAND AND GRAVEL REWASHED ON THE JOB

About half way between Royal Oak and Birmingham a Stocker sand and gravel washing plant has been erected. Pit run material is brought to it in large, steel hopper cars, which empty directly into a pit beneath the track. A bucket elevator, operated by a 5-hp. electric motor, carries the material directly to the screen. On the opposite side of the plant water is pumped in, through a 3-in. pipe, from a pond about 100 yd. away, formed for the purpose by damming a small creek. The plant has a capacity of 15 cu. yd. per hour.

The sand and gravel after being separated and washed are held in Weller portable storage bins until required, when they are dropped into steel industrial cars, which run direct to the mixer. Cement, kept in box cars on a siding of the interurban line which parallels the road, is also distributed from this central point.

It has been found that the washing operation adds but little to the cost of handling the material. Supposedly washed material has been purchased and tested but found to be more or less unsatisfactory. The washing operation being performed directly on the job and under the supervision of the engineers in the employ of both the contractor and the county has resulted in obtaining a high quality of material.

The specifications originally called for a mix of 1 cement, 1½ sand and 3 gravel, but it was found that the aggregate was of such a quality that a better concrete would be made by raising the proportion of sand from 1½ to 2. Universal Portland cement was used.

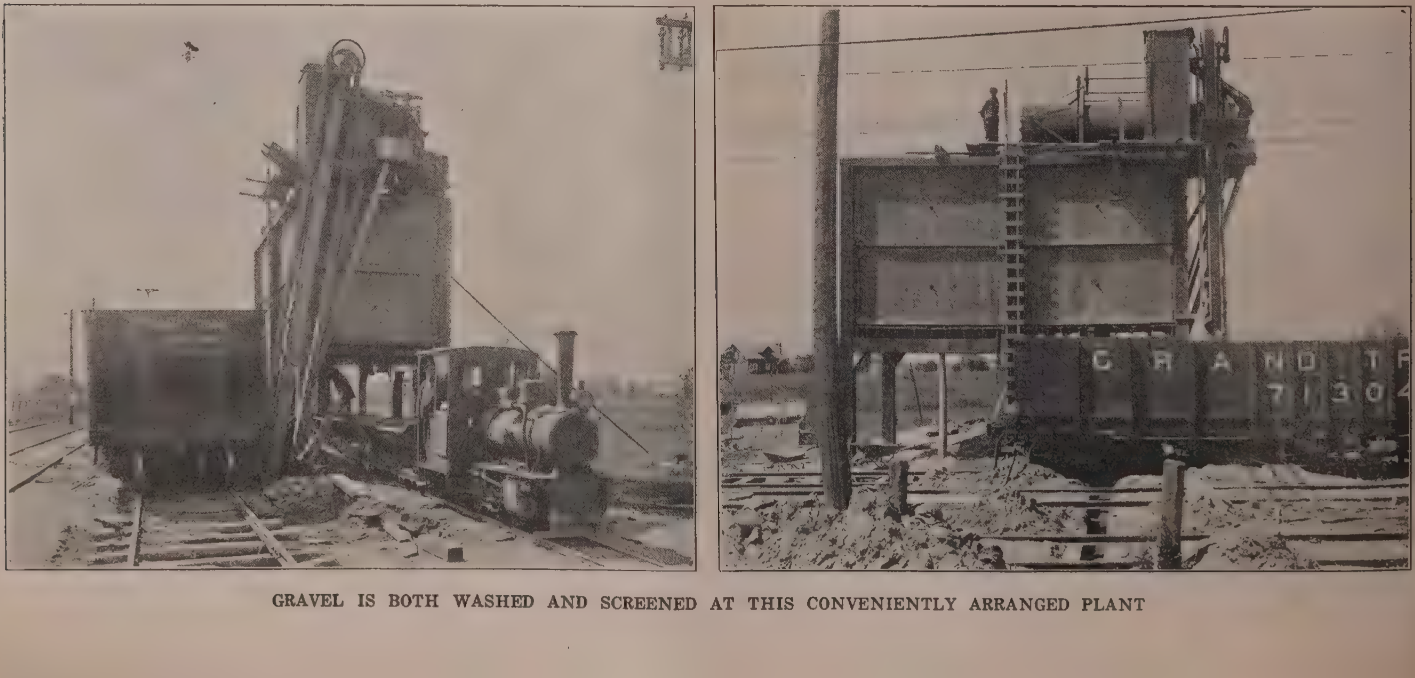
FROM BINS TO ROAD

All materials are delivered to the storage bins by interurban cars. The bins have a storage capacity of 60 cu. yd. of sand and 60 cu. yd. of stone. Sixteen-car industrial trains, made up of 1½-cu. yd. Koppel cars, hauled by an 8½-ton steam locomotive, are run on a 24-in. gage track from the central washing plant to the mixer. At the mixer plant, the cars dump their loads of cement, sand and stone onto the grade and from there it is delivered to the mixer skip. The 16-ft. Koehring mixer keeps twelve wheelbarrows busy feeding it with material.

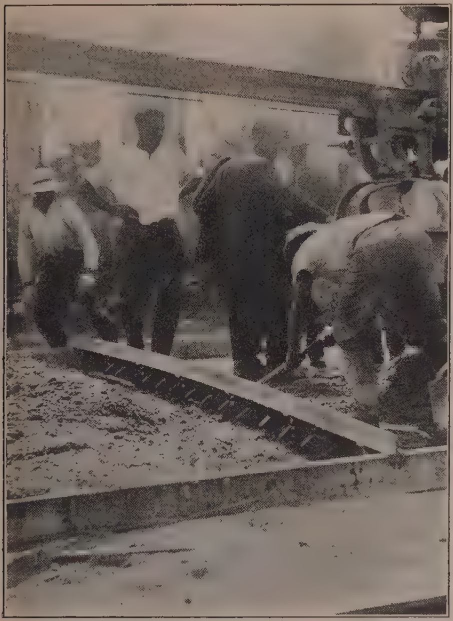
The industrial railway has been found not only to reduce haulage costs but has left the subgrade in such good condition that the work has been allowed to proceed smoothly and rapidly. One man is employed keeping the 2 miles of track in shape. The contractor figures that the total haulage costs run below 6 cents per ton-mile.

BETTER FINISH AT HALF THE COST

Instead of finishing and leveling the surface of the road by hand and template, a Baker finishing machine is used. As may be seen from the accompanying photograph, it runs on the steel side rails. It consists of five distinct and detachable parts, which facilitate moving from job to job. First are the two trucks, which run on the side rails, supporting the oscillating strike, vibrating and compressing pan, and the finishing float, all of which extend the full width of the roadway. Mounted upon one of the trucks is a 3-hp. gasoline engine, which transmits power to oscillate the strike and finishing float, and also to vibrate the pan. It also revolves drums which pull the machine forward by means of cables attached to the side rails. The strike can be raised or lowered by means of a lever, which enables the operator to feed back to the vibrating pan sufficient material to make a smooth, compact surface. The vibrating pan can be adjusted to increase or decrease both the amount of compression and vibration, and these changes are necessary in order to take care of the wide variation in the quality of materials. On this work, behind the concrete mixer,



GRAVEL IS BOTH WASHED AND SCREENED AT THIS CONVENIENTLY ARRANGED PLANT



STEEL EXPANSION JOINT IN POSITION

there are used two graders, the finishing-machine operator, and one man to dress up the edges of the road before taking down the side rails. It has finished as high as 600 linear feet of this 16-ft. roadway in a working day, and a regular progress of 500 ft. or more is secured. The machine is raised slightly when crossing the steel expansion joints.

The engineers in charge state that the finisher gives a better concrete surface than is obtained by hand, due to the tamping obtained by the machine vibrators. That it effects a considerable saving in labor as compared with the hand method of finishing is shown in the accompanying table.

Armored joints, with Elastite expansion material, are spaced 30 ft. apart. Baker steel side rails are used. Two men are able to keep this part of the work moving as rapidly as the rest of the job and are also able to take care of the grade stakes.

The work, which was awarded in June, will be finished about Sept. 1. The contract price was $60,000. An idea of the rapidity with which progress is being made may be gleaned from the fact that an average of 800 sq. yd. of concrete is being laid per 10-hr. day.

COST OF FINISHING BY HAND AND BY MACHINE

	Per Hour	10 Hours
By Hand		
2 graders at..................	$0.25	$5.00
5 strike men at..............	0.225	11.25
2 helpers at....................	0.225	4.50
2 finishers at..................	0.50	10.00
One hour overtime for finishers to catch up at end of day and noon....		1.00
		$31.75
By Machine		
3 graders at....................	$0.25	$7.50
1 machine man at............	0.35	3.50
1 finisher at....................	0.50	5.00
Gasoline and oil per day.............		0.20
		$16.20

PERSONNEL

The R. D. Baker Company, Detroit, is the contractor. Mr. Baker's construction superintendent is Frank Longman. Frank B. Tanner is the inspector for the county and Martin De Glopper is the county engineer.

NARROW-GAGE TRACK LAID WITHIN ROADBED LINES ON MICHIGAN ROAD JOB

Eye Is Best Means of Controlling Consistency of Mix

This Contention Made by Company Which Produces Large Quantities of Reinforced-Concrete Pipe

EYE MEASUREMENT, so the Lock-Joint Pipe Company, of New York, contends, is the best method of controlling the quantity of mixing water for concrete in thin sections wherever the highest grade of workmanship is required. The company's product consists of reinforced-concrete pipe, which is subjected to severe inspection because every length can easily be examined in the casting yard. Segregation of aggregate, lean mixtures, excess of laitance are all readily apparent. Every batch, too, shows up in the product practically by itself, so that a dry batch will not be helped out, as in mass work, by a following wet one. Furthermore, much of the pipe is used under pressure, which necessitates most thorough mixing, besides puddling and proper grading, in order to stand the service. As to thorough mixing, also, the company contends that the eye is the best judge.

As a result of long study the company has demonstrated to its satisfaction that even the variation in moisture in different parts of sand banks affects the consistency of mix, and, therefore, the character of product. For this reason it has discarded water-measuring tanks, since the variations required cannot with these tanks be made until a batch has been discharged and its consistency observed to be unsatisfactory. In mass work this batch, somewhat too wet or too dry, is brought to average by preceding and later batches. The company found that for its work constant manipulation of measuring tanks was necessary, and that even then the moisture content of the aggregate varied so much that the measuring tank necessarily lagged behind the vagaries.

OPEN MIXER USED

To carry its theories into practice the company has equipped itself with the open type of mixer, such as the Little Wonder and the Big and Little. One of these mixers is shown on pages 177 and 178. The batch is dumped by revolving the axis of the drum through an angle of 180 deg., so that it will discharge on the opposite side of the truck. It is apparent that a man standing on a platform somewhat above the level of the bed of the truck on which the mixer is mounted can watch closely the progress of the mixing.

Before proceeding, it should be remarked that the company also has a theory as to the order in which the ingredients of a batch should go into the drum. Instead of putting in the aggregate and the cement first and finally the water, it is the company's practice to put in the water first and then the cement. After this has been turned half a dozen times, securing a uniform thin grout the aggregate is added. It is the company's contention that more even distribution of the cement is insured by this practice than with other systems of charging.

CONTROLLING THE MIX

Returning to the method of controlling the mix, it is the practice to mount the mixer operator on the charging platform, shown in the illustrations. From a handy barrel he throws into the mixer a quantity of water somewhat less than he thinks will be necessary. Next the cement is put in and, after some turns, the aggregate. Watching the progress of the mix carefully he adds water as is needed to bring the mass to the desired consistency, and when it is entirely homogeneous, dumps it.

As a further check on the correctness of the mix, it is discharged in the first instance not into barrows or carts for transportation to the forms, but into a large pan, where the consistency can further be observed. If the consistency is not correct the batch is discarded.

In order to use the open type of mixer economically the company has devised special charging barrows and certain auxiliary kinks which are described in this issue under the heading "Hints to the Contractor."

METERS IN MEMPHIS now number 15,190, 1704 having been installed during 1914. During the year 1269 meters were repaired, 1281 were changed, 18 were started that had stopped, 301 leaking meters were repaired, 576 were inspected and found in order, 28 were repaired in the ground, 16 broken meter boxes were replaced and 101 lids were replaced.

Continuity of Policy and Experienced Personnel Necessary for Service Boards

These Principles and Single Commission Urged Upon New York Constitutional Convention by Committee of Engineers

IN ORDER to carry out the views of the Committee of Engineers representing National and local engineering societies (printed in the Engineering Record of May 1, 1915, page 561), Olin H. Landreth, professor of engineering in Union College, has introduced an appropriate amendment in the New York State Constitutional Convention. Professor Landreth, by the way, is the only engineer delegate to the convention. The sub-committee on public utilities of the Committee of Engineers has now addressed a letter to the committee on public utilities of the convention, urging the importance of the features embodied in this amendment, which is but one of several offered as a solution of the public-service control problem. Because of the importance of the subject and the fact that the amendment is being urged by those whose engineering training and familiarity with both public-service companies and public-service control enables them to speak with authority, the amendment and the sub-committee's letter are here reproduced in full.

THE AMENDMENT

The amendment is as follows:

"A public service commission of five members shall be appointed by the Governor by and with the advice and consent of the Senate. Each commissioner shall hold office for ten years. The terms of the commissioners shall be so arranged that the term of one member shall expire upon the first day of February in alternate years. Each commissioner should have had experience in connection with public utilities which would fit him for the duties of the office.

"The commission shall regulate and supervise all common carriers, all water supply, irrigation, drainage, gas, power, lighting, heating, intelligence-transmitting and other public utility corporations operating within the limits of New York State, including similar activities on the part of any other State department or political subdivision of the State.

"Removal by the Governor of any commissioner should be made only after the filing of charges and after affording the accused an opportunity to be heard in the matter, provided, however, that at any time within the first six months after making an appointment the Governor may exercise the power of summary removal. A successor to a commissioner who has been removed should be appointed to fill the unexpired term.

"Vacancies caused by removal or otherwise should be filled under conditions similar to those governing original appointment."

SUB-COMMITTEE'S LETTER

The letter of the sub-committee, signed by Charles Whiting Baker, as chairman, Gano Dunn and W. W. Brush, is as follows:

The thing which we consider of greatest importance in any plan for organization of a State public utility commission is the preservation of the principle of continuity already established in the present public service commissions. By this we refer to the system whereby the term of office of the members of the commission expire at different times, so that only one member of the commission at a time goes out of office. Under this plan, a new member has the advantage of association with colleagues who have had years of experience in the work. Thus the plans, policy and methods of the commission are continued with only such gradual change as experience may develop, and without the delays and unnecessary, and at times undesirable, changes which would be certain to occur if the entire membership of the commission were changed at one time.

Experience has proved also that under this form of organization the staff of the commission is a permanent, organized body. It can readily be understood that with the great responsibilities laid upon the public service commission, the members of the commission must devote their time to questions of general policy and the detail work must be done by the commission's staff of engineers, attorneys, accountants, etc. The character of the work done by the commission will depend very much on the sort of men it secures for its staff, and it can secure very much better men if those appointed hold their positions continuously as long as they display ability in the discharge of their duties.

If, however, a change were to be made in the public-service law so that an entirely new commission would be appointed with each new gubernatorial administration, there would be danger not only that the commissioners would be appointees without the experience and knowledge necessary to formulate and carry on a sound constructive policy, but that the principal employees of the commission would be changed for political or personal reasons with the coming in of each new commission.

QUALIFICATIONS OF COMMISSIONERS

The second important thing that we would urge upon your honorable body is the embodiment of some provision in the Constitution setting forth the general qualifications which candidates for the position of public service commissioner should possess.

There is no doubt that State and Federal control of those monopolies generally known as public utilities is here to stay; but it is a serious question whether these great powers of control will be so wisely and justly exercised that on the one hand the public will be satisfied and on the other hand the public utility corporations may be able to continue in business and meet the requirements placed upon them.

The vast responsibilities placed upon these public service commissions are hardly realized as they should be. Upon their proper handling of the very difficult questions before them depends the welfare, the prosperity, the safety of millions of people.

It is unfortunately the case that many of the appointments to State public service commissions have been of men who had not sufficient experience or ability to properly fill these positions. We have, therefore, proposed for incorporation into the Constitution the requirement that any man appointed to membership in the public service commission "should have had experience in connection with public utilities which would fit him for the duties of his office."

The questions which come before a public service commission require for their intelligent decision intimate acquaintance with technical matters, financial matters, commercial matters, legal matters. There can be no question that men who are already familiar with matters of this sort from experience in the management of public utilities can render much more valuable service in the control of these utilities than men who are without such experience.

BROAD-MINDED MEN TO BE HAD

There are to be found among those connected with public utility companies men with as broad conceptions of public rights and of the duties to be fulfilled to the public as can be found in other walks of life. We believe that such experienced men, knowing well what can be done and what cannot be done, would be able to deal more firmly with the companies than would members of a commission who lacked such technical experience.

It should be understood, moreover, that the constitutional requirement we have suggested—previous experience in connection with public utilities as a requisite to a commissioner's appointment—is not to be construed as a rigid limitation upon the Governor's discretion in making appointments. The responsibility would properly be upon the Governor to judge as to how much experience was requisite to fit a candidate for appointment. The value of such requirements embodied in a statute, or a constitution, is that they define the requirement which the Governor should have in mind in the selection of candidates. It is not pretended that this requirement or any other which could be framed could prevent the selection of unfit candidates. It is believed that such clauses are of value, nevertheless, in setting up a standard to which most men in the long run will seek to conform.

ONE PUBLIC SERVICE COMMISSION

The third important feature of our recommendation is that there should be one public service commission for the whole State instead of two as at present, it being understood that under such a proposed reorganization the work of constructing and administering the New York City rapid transit system would be transferred to the city, which now owns the system, and would cease to be a State function.

New York is the only State which has two separate public service commissions. The reason why New York has two commissions has to do with conditions which existed a quarter century ago and which do not exist at the present day.

Great as is the task of controlling in the public interest all the public utility operations of the Empire State, it is certainly much more easily within the powers of a single commission of five men to do this than it is within the powers of the seven men of the Interstate Commerce Commission to control the utilities of the entire nation, with its population of a hundred million. By having a single commission for the entire State, moreover, certain difficult questions as to division of responsibility between the two commissions are set permanently at rest.

While we heartily believe in this feature which we have recommended, we consider it unimportant in comparison with the other two features which we have discussed above. If your honorable body shall see fit in its discretion to provide for the perpetuation of the principle of continuous organization in the control of public utilities, and shall provide that public service commissioners shall have had previous experience which would fit them for the duties of their office, the main purposes of our committee will have been accomplished.

Diagrams Facilitate Estimating Highway Bridges

G. F. Burch Plots Curves for Steel and Concrete Required in Standard Spans of Illinois Highway Department

HELPFUL diagrams for use in the selection of the most economical type and in making estimates for highway bridges have been plotted by G. F. Burch, assistant bridge engineer, Illinois Highway Department, based upon the standard plans of bridges prepared by that department and the quantities of material in many standard designs. These diagrams, which were published in the June issue of "Illinois Highways," give the weight of steel and the amount of concrete in steel truss spans from 50 to 160 ft. long, with a 4-in. concrete floor, in reinforced-concrete girder spans from 30 to 60 ft. long, and in reinforced-concrete slabs from 5 to 30 ft. long. In addition curves are given for the amount of concrete in the abutments, both plain and reinforced.

The following abstract includes the essential data for all except the reinforced-concrete abutments, which are omitted because of limited space and the fact that the weight of the steel reinforcement is not given and no detail plans are included. The curves given are for quantities only. The cost of labor and material must be determined for each and every job and applied to the given quantities, which are intended primarily for use in the field.

MATERIAL IN SUPERSTRUCTURES

The steel trusses are of the ordinary Pratt truss type with parallel chords and riveted connections. The design provides for a 4-in. concrete floor, with a wearing surface assumed to weigh not less than 50 lb. per square foot. On account of the weight and rigidity of the concrete floor no allowance is made for impact. Floor systems are designed to carry a 15-ton traction engine in addition to the dead load. Trusses are designed to carry a uniform load of 100 lb. per square foot of road surface for spans from 50 to 150 ft., and a uniform load of 85 lb. for spans exceeding 150 ft. long. The usual A. R. E. A. unit stresses are used in the design. Pony trusses are used for spans of from 50 to 85 ft., and through trusses for spans of from 90 to 160 ft.

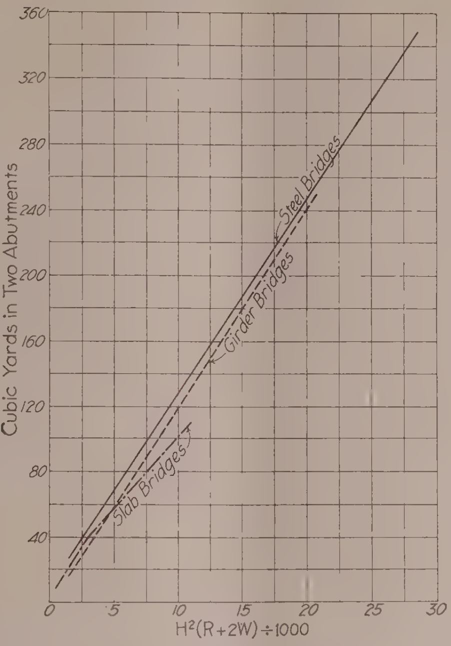


FIG. 4—PLAIN CONCRETE ABUTMENTS FOR THREE TYPES OF BRIDGES

Fig. 1 gives the curves for the weight of structural steel, and the yardage of concrete in floors, for 16 and 18-ft. roadways. The break in the steel curves is at the point where the change is made from low to high trusses.

Reinforced-concrete through girders are used for spans of from 30 to 60 ft. This type of structure is designed to carry either a uniform load of 125 lb. per square foot, or an engine load of 24 tons. The design provides for a wearing surface weighing 50 lb. per square foot. As free expansion and contraction are allowed by the cast-iron rockers placed under each girder at one end of the spans, the allowable unit stresses used are quite high. Designs are figured for a steel stress of 16,000 lb. per square inch and a compression stress in the concrete of approximately 1000 lb. per square inch. A maximum unit shear of 120 lb. per square inch is allowed. Stirrups are provided for all shear in excess of 40 lb. per square inch. Fig. 2 shows curves giving the quantities of concrete and reinforcing steel for 16, 18 and 20-ft. roadways.

For spans less than 30 ft. the slab type of construction has been found to be somewhat cheaper than the girder type, due to the fact that the arrangement of the steel is much simpler and less steel is used per cubic yard of concrete. It has not been found practicable to make provision for free expansion of slabs. Accordingly, a stress of 12,000 lb. per square inch of reinforcing steel is allowed for dead-load and live-load stresses. The concrete stress is 800 lb. per square inch. Slabs are designed for the same live load as girders. Fig. 3 gives the quantities of concrete and steel in slabs having clear roadways of 16, 18, 20, and 24 ft., for spans of from 5 to 30 ft.

PLAIN CONCRETE ABUTMENTS

In preparing curves to show the quantities in abutments it was found that there were many variables which might be considered, but which if used would produce such complex formulas as to make the curves of little use in the field. It was found that curves giving reliable results might be obtained by plotting the cubic yards of concrete in two abutments against a formula which represented a measure of the quantities desired. The variables in this formula are H, height of abutment from bottom of foundation to top of roadway; R, clear width of roadway on superstructure, and W, length of average wing wall. For plain concrete abutments the best results were obtained by using the term $H^2 (R+2W)$.

Plain concrete abutments for steel bridges are designed with a footing width of one-third of the height over all, and the thickness of the footing is usually from 18 to 24 in. The width of the base of the

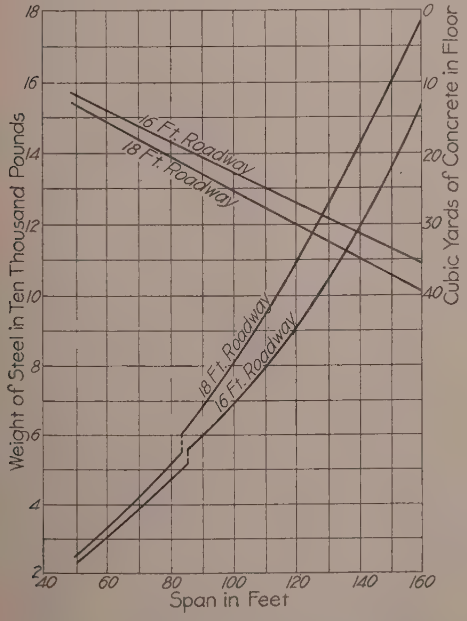


FIG. 1—STEEL TRUSS SUPERSTRUCTURES

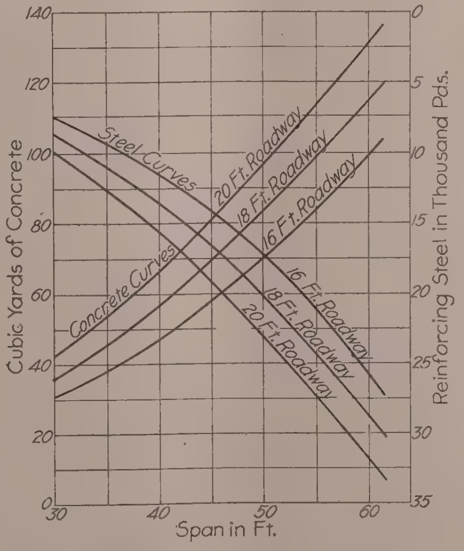


FIG. 2—REINFORCED CONCRETE THROUGH GIRDER SUPERSTRUCTURES

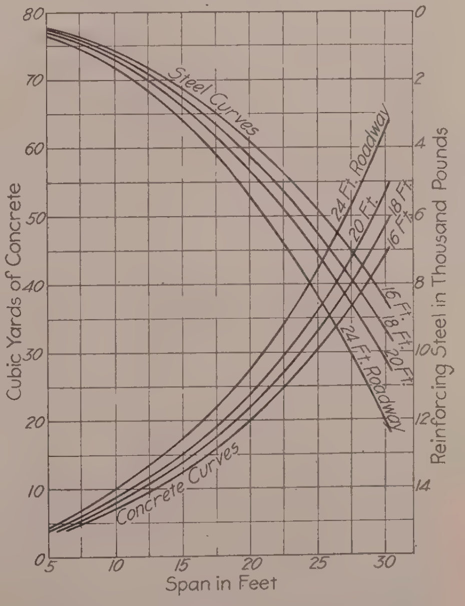


FIG. 3—REINFORCED-CONCRETE SLAB SUPERSTRUCTURES

abutment and wing walls at the top of the footing is made approximately one-quarter of the height of the walls. The back of the abutment wall is vertical and the face of the wall is battered to a top width of from 30 to 38 in. The wing walls are battered on both sides and have a top width of 12 in. Fig. 4 shows the curves from which the yardage of plain concrete abutments for steel bridges may be obtained. When field measurements are made to determine the necessary height of abutments, and the width of roadway is decided upon, it is easy to estimate the length of wing walls which will be required. These figures are then used in the formula and the yardage of concrete is read directly from the curve.

The design of plain concrete abutments for girder bridges is similar to the design for steel bridges, except that the wing walls are battered on the face side only, and the top width of the abutment wall is 18 in. Fig. 4 shows the curve from which quantities for this type of abutment are obtained. Plain concrete abutments for slab bridges differ slightly from the preceding design. The width of footing on the abutment wall is limited only by the safe bearing capacity of the soil, with a minimum of 3 ft. This width may sometimes be less than one-third of the height. This is deemed to be safe on account of the restraining effects of the superstructure. The top width of the abutment wall is 12 in. and the curve for estimating the yardage is shown in Fig. 4.

When these curves are used for plans based on the Illinois Highway Department's standards, the maximum error for superstructures is only about 3½ per cent and for substructures about 5 per cent.

Yellowstone Park Automobile Regulations Now in Effect

REGULATIONS governing the admission of automobiles into the Yellowstone National Park for the season of 1915 became effective Aug. 1. The park is open only to such automobiles as are operated for pleasure, and not to those carrying passengers who are paying for the use of the machine. Motorcycles are not permitted to enter the park. Tickets for passages must be secured and paid for at the checking station where the automobile enters the park. These will show name of owner, license number of automobile, name of State issuing license, make of machine and manufacturer's number, name of driver, seating capacity and number of passengers.

Muffler cut-outs must be closed while approaching or passing riding horses or horse-drawn vehicles, camps, hotels, or soldier stations. The machines, while in motion, must not be less than 100 yd. apart, except for the purpose of passing, which is only permissible on comparatively level or slight grades. All machines, except while shifting gears, must retain their gears constantly enmeshed. The machines on entering the park must be in good working order. There must be sufficient gasoline in the tanks to reach the next place where it can be obtained, and two extra tires must be carried.

Speeds are limited to 12 miles per hour, ascending, and 10 miles per hour, descending, steep grades, and to 8 miles per hour when approaching sharp curves. On good roads, with straight stretches, and when no team is nearer than 200 yd., the speed may be increased to 20 miles per hour. Horns must be sounded at all curves where the road cannot be seen for at least 200 yd. ahead and when approaching teams or riding animals. Teams have the right-of-way, and automobiles must be backed, or otherwise handled to enable them to pass with safety. In no case may automobiles pass animals on the road with a greater speed than 8 miles per hour. Fines or other penalties will be imposed for the arrival of automobiles at any point before they are due to arrive, according to an established schedule which is published with the regulations.

These regulations and schedules do not apply to automobiles passing over the country road in the northwest corner of the park, en route for the town of Yellowstone.

Literature

For the Civil Engineer and Contractor

New Publications

PRACTICAL TRACK WORK. By Kenneth L. Van Auken. Cloth, 5½ x 8 in.; 216 pages; illustrated. Chicago, Railway Educational Press, Inc. $1.50.

WATER SUPPLY PAPER 342—Surface Water Supply of the Yukon-Tanana Region, Alaska. By C. E. Ellsworth and R. W. Davenport. 343 pages, illustrated, 2 inserts.

GUIDE TO THE REPORTS OF THE ROYAL COMMISSION ON SEWAGE DISPOSAL. By G. Bertram Kershaw, engineer to the commission. Cloth: 5¼ x 8¼ in.; 178 pages. London, P. S. King & Son, Ltd. $1.25 net.

PROGRESS REPORTS OF EXPERIMENTS IN DUST PREVENTION AND ROAD PRESERVATION, 1914. Bulletin 257, U. S. Department of Agriculture. Paper; 6 x 9 in.; 44 pages, 25 tables. Washington, Government Printing Office.

OIL-MIXED PORTLAND CEMENT CONCRETE. By Logan Waller Page, director, Office of Public Roads. Bulletin 230, U. S. Department of Agriculture. Pamphlet 6 x 9 in.; 26 pages, illustrated. Washington, Government Printing Office.

Books Reviewed

Catalog of Technical Periodicals

Compiled for libraries in the city of New York and vicinity by the assistant librarian, Alice Jane Gates, with the co-operation of a committee of the New York Library Club. Cloth; 8 x 10½ in.; 110 pages. New York, Library Board of the United Engineering Society. $3.

Following the original suggestion of Dr. John Shaw Billings, made in February, 1911, to W. P. Cutter, librarian of the Engineering Societies, this catalog was begun and has just been completed. It is a valuable aid to those engineers who are searching technical periodicals, as it gives the location of the sets of periodicals and transactions to which they may wish to refer. The book is the result of the authorization and approval of the governing body of the Library Board of the United Engineering Society, and contains about 2600 main entries and cross references, with an entry for all general indexes, and a statement of the library or libraries in which each periodical may be found.

The following libraries are included:

The New York Public Library, the Library of Columbia University, the Library of the American Society of Civil Engineers, the Library of the Chemists' Club, the Library of the Stevens Institute of Technology, the Public Library of Plainfield, N. J., and the Library of the Engineering Societies.

This work is part of an extensive plan to include, ultimately, other sections of the United States and Canada. The question of a subject classification of all engineering knowledge is also being considered, and it is hoped that a more satisfactory system than the present inadequate Dewey decimal system will result with the publication of a subject index. This first book is well printed, and is arranged to facilitate the location of references. In giving the history of changes of names of old periodicals it is of general interest in addition to its value as a reference work.

Conservation of Water by Storage

Author, George Fillmore Swain, LL.D., Gordon MacKay professor of civil engineering in Harvard University. Cloth, 7 x 10 in.; 384 pages, 91 illustrations. New Haven, Conn., Yale University Press. $3 net.

Reviewed by Morris Knowles

Consulting Engineer, Pittsburgh

Occasionally there appears a work which marks an epoch in the field of endeavor to which it belongs, and which therefore stands pre-eminent in that field. Such a work is the book entitled "Conservation of Water by Storage," for which we are indebted to Dr. George F. Swain, Gordon MacKay professor of civil engineering in Harvard University, past president of the American Society of Civil Engineers, Chairman of the Fourth Conservation Congress, etc. The volume comprises a series of lectures given by Professor Swain at Yale University in 1914, the composition of the book being such that these essays constitute a coherent and perfectly balanced treatise.

The work discusses the fundamental aspects of conservation from the point of view of public welfare and enlightened citizenship and omits any discussion of the subordinate matters of design and construction. It is readable, being popular rather than technical in character, which should add greatly to its usefulness.

Neither the facts used, nor the conclusions reached are, for the most part, new. The author quotes extensively from the leading reports on conservation, and from the opinions of prominent conservationists. But in a field where much of the discussion has been characterized by confusion of issues, ignorance of fundamentals and fallacious reasoning, the work is pre-eminent in its convincing logic and in its clear-sighted refusal to be misled by the dilemmas arising from considerations which, though of importance, are shown to be foreign to the real subject.

The opening chapter deals with conservation in general and the facts concerning waste of our natural resources are brought out succinctly and with startling emphasis. The true conservationist is defined as he who believes in the avoidance of preventable waste, in contrast to the "so-called" or "self-styled" conservationist who confuses all sorts of social, economic and governmental policies with conservation; and this idea is insisted upon and often reiterated throughout the book.

The relations and differences between water and other natural resources are discussed in chapter 2. Natural resources are divided into three classes from the point of view of conservation: (1) "Those resources which are not renewable," e. g., mineral deposits; (2) "Those resources which are self-renewing, though at a comparatively slow rate, requiring considerable time for a complete renewal," e. g., forests; (3) "Water power falls in a different class from either of the above. . . . While resources of the first two kinds, if not utilized, are in general stored and preserved for the use of future generations, water power, if not utilized, is constantly wasting with no good results to anybody."

The author then points out that the use of water not only prevents its own waste, but such use replaces an equivalent amount of fuel which is thus conserved. He states that, "Any use is better than no use at all, because every use conserves a non-renewable resource and is also or may also be made an aid to navigation. In one case, therefore, our guiding principle is restriction. In the other case it is the encouragement of the greatest possible development. If any one disagrees with this proposition he must disagree with it, not as a conservationist, but from some other point of view."

The author then goes at length (chapters 3, 4 and 5) into the legal and legislative aspects of the "water-power question," with particular reference to the controversy over Federal control of water power. This part of the work is without doubt the most thorough digest and discussion of this matter ever presented in a single work.

The important distinction is clearly drawn between the rights of the government, as owner of public lands, or of riparian lands, and rights purchased at dam sites on navigable streams—and its constitutional power to regulate commerce. The limited application of this latter power to private development of water on navigable streams is convincingly argued. The General Dam Act and the water-power policy of recent administrations are criticised in detail, and it is shown that they have discouraged, rather than encouraged, water utilization, and thus have hindered true conservation.

Finally, the author submits a constructive program for a water-power policy designed to promote water conservation, both on government-owned and privately-owned riparian lands.

Chapter 6 deals with "The Technical Aspects of Conservation," and in a pleasing style presents the various uses of water storage, the fundamental technical problems confronting the hydraulic engineer, the effect of storage on the uniformity of stream flow and the use of water as a source of power for water supply, for irrigation and for navigation.

The discussion on "Forests and Stream Flow," in chapter 7, is perhaps the most remarkable in the book. Dr. Swain attributes the confusion which has obscured this subject largely to the attempted use of inductive reasoning on a problem which can be solved only by deduction. The manifest error of extremists on both sides is emphasized and the conclusion is reached, in a manner which should convince the most skeptical, that the truth lies somewhere in the middle ground; that forests do regulate stream flow to some extent, and that upon steep mountain sides especially they exercise a restraining effect upon run-off and are of inestimable benefit in preventing erosion of the soil.

The work closes with a chapter on "Floods" which is both descriptive and technical. An analysis of the methods of flood prevention is presented and its relation to water conservation discussed. In general, stress is laid upon the importance of a thorough and comprehensive engineering investigation of each particular case.

The reader is introduced to the volume by a quotation from Bacon:

"Read not to contradict and confute, nor to believe and take for granted, nor to find talk and discourse, but to weigh and consider."

It is earnestly to be hoped that many will heed. A study of this volume should prove invaluable to legislator and engineer alike.

Building Code Recommended by the National Board of Fire Underwriters

Fourth Edition Completely Revised, 1915. Flexible cloth; 5 x 7½ in.; 326 pages, illustrated. New York, National Board of Fire Underwriters.

This noteworthy attempt to produce a standard building code of such excellence that it will recommend itself to all city authorities and tend to bring about much-needed uniformity in such codes, is issued by the committee on construction of buildings, and written by Ira W. Woolson, consulting engineer of the National Board of Fire Underwriters. It incorporates the most advanced requirements in fire-protective building construction, and in the field of materials and allowable working stresses has taken a firm stand for conservative and safe standard practice. The many principal points in which this new edition is an improvement over the old were mentioned in the announcement in the Engineering Record of June 5.

The requirement for a certificate of occupancy stating the purpose of use, maximum allowable live load and maximum number of persons allowed per floor, and prohibiting use for any other purpose marks a distinct advance in code regulations. Change of occupancy is permitted only under a new certificate. In classifying buildings both according to construction and by occupancy, the code is well written and definite. The requirements for fireproof construction contain severe limitations on the use of combustible materials.

The limiting allowable thicknesses for brick walls are clearly shown by diagrams and tables. Hollow-block construction is permitted for all walls except party and fire walls in buildings not over 40 ft. high, the minimum thickness being the same as for brick walls. Instead of limiting the thickness of the terra-cotta hollow blocks, the allowable stress is based upon the gross sectional area of the bedding faces. Factors of safety of 10 are prescribed, and minimum average test values given for use with cells vertical and cells horizontal. Comparing these with the newly adopted requirements in the New York code, it is seen that the latter allow a lower value for cells vertical (100 vs. 120) and a higher value for cells horizontal (50 vs. 30). It is worthy of comment that the New York code allows 150 lb. per square inch on hollow concrete blocks filled with concrete, an increase of 100 per cent, while the proposed code of the National Board makes no increase in allowable stress; an explanatory note states that tests have not shown sufficient gain due to filling with concrete to warrant recognition.

TABLE OF ALLOWABLE UNIT STRESSES IN TIMBER

	Bending		Compression	
	Extreme Fiber Stress	Maximum Longitudinal Shear	Perpendicular to the Grain	Parallel to the Grain Columns with l/d—less than 10
Oak	1,400	120	400	1,000
Yellow pine, Grade I..	1,600	120	350	1,200
Yellow pine, Grade II.	1,200	85	300	900
Douglas fir...........	1,500	100	300	1,100
Eastern spruce	1,000	75	200	900
Western hemlock	1,300	75	250	1,000
Norway pine	1,000	75	250	800

l = unsupported length in inches.
d = diameter or least side in inches.

Where a moderate increase in deflection after first placement of the load is not objectionable, the compression and extreme fiber stresses here given may be increased 10 per cent. Stresses for timbers subject to vibration and impact should not be thus increased.

Except for shear, the same stresses may be used for Douglas fir of grades I and II as for yellow pine of grades I and II, provided the fir is selected in a manner to insure material of corresponding quality.

The sections specifying allowable floor areas between fire walls very properly increase the allowances by large percentages when sprinklers are used. The method of limiting the area according to the number of frontages on streets is an excellent principle. The limits to height are conservative and probably would prove to be a source of difficulty if introduced into any proposed city code. Provisions for safety egress, specifying size of doors, number and width of exits, and ruling against elevators, escalators and revolving doors as fire exits are included. In the treatment of outside stairways, fire or smoke-proof towers, and details of their construction, the code is most complete and represents the best requirements in this direction.

The sections treating materials and allowable working stresses follow the usual standard practice. The A. R. E. A. straight-line formula for steel columns is specified, except that the maximum allowable unit stress is made 13,000 instead of 14,000. This requirement is wholly justified by results of recent tests, which show that for l/r below about 50, the crippling load, is practically constant. In this respect the code is superior to the revised New York code, which prescribes the same formula without any maximum upper limit whatever. Both codes use the same formula for cast-iron columns.

The allowable stresses in timber are based upon the latest reports of the U. S. Forest Service and definitely abandon the terms longleaf and shortleaf yellow pine in favor of precise grading rules. This is a most advisable move. The inclusion in the Appendix of the grading rules proposed by the U. S. Government materially adds to the value of the volume, and should result in the more general adoption of this scientific method of grading yellow-pine timber. The timber unit stresses mark so important a change in practice that they are here given in full. They apply only to seasoned timber kept in a dry location.

The requirements for reinforced-concrete construction and working stresses follow the Joint Committee recommendations. Especially conservative are the specified bending moments in two-way flat slab construction on girderless floors, when compared with the allowable values in the new Chicago code. The provisions include limiting the time for removal of forms, and to prevent freezing are to be commended. The recommended strength tests for floors and factor of safety based upon third-point loading mark a notable advance in test methods.

The complete treatment of the subjects of interior vertical openings, provisions for light and ventilation, and for automatic sprinklers, together with the beam tables in the appendix and the suggestive explanatory notes and references scattered throughout the text make the book most satisfactory as a helpful guide to the best modern thought on the subject of proper building laws for cities.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Sloping Versus Curved Crowns for Highways

SIR: The interest of the writer has been attracted to the experiments of S. C. Marcus of Watsonville, Cal., one of the supervisors of Santa Cruz County, in constructing country roads with a sloping crown rather than with a parabolic-curve or circular-curve method. Mr. Marcus has used successfully a straight slope from the center each way to the sides. He has constructed some 8 or 10 miles of this kind of road, a considerable part of which is a type of oil macadam similar to that used in this section of California. This road presents a firm, smooth asphaltic appearance. The slope used, noted above, has been ample for drainage purposes, and the road does not present an unsightly appearance.

It appeals to the writer that such a type of crown has many advantages, and that the familiar circular type has many disadvantages. Particularly is this true of country roads which have to bear high-speed automobile traffic. The arguments which appeal to the writer in favor of this sloping type of crown over the circular type commonly used are:

1. It is possible, by using this type of road, to do nearly all of the grading and spreading with a road grader or a drag. This advantage is fairly obvious and in practice works out favorably to the sloping type.
2. A much more uniform distribution of traffic is obtained.
3. The pleasure of riding on the road is greatly enhanced. With an automobile passing any other vehicle and traveling at the rate of 20 miles an hour, as the automobile approaches the edge of the curved road there is a distinct falling tendency, also a tendency to skid, which is felt unpleasantly by the occupants of the machine.
4. Any extra widening in the roadway is much more easily accomplished.
5. By reason of the better distribution of traffic and the elimination of the skidding action, maintenance charges on the road should be considerably reduced.
6. The flat place in the center of the road which is commonly used by a large percentage of the traffic is entirely eliminated. There is too little slope over the center of the road in the present type of crown used, which makes a rather serious lack of drainage.

There is no perceptible difference from an æsthetic standpoint in the appearance of the two classes of road. Should it be desired to construct gutters which would keep drainage off the roadway, this may be easily done by dishing them slightly or sloping them more rapidly. The rate of slope could, of course, be changed to meet conditions, but that used by Mr. Marcus has worked out very satisfactorily.

The matter of a more equitable distribution of traffic should appeal very strongly to engineers.

The writer should like to hear a discussion of this matter.

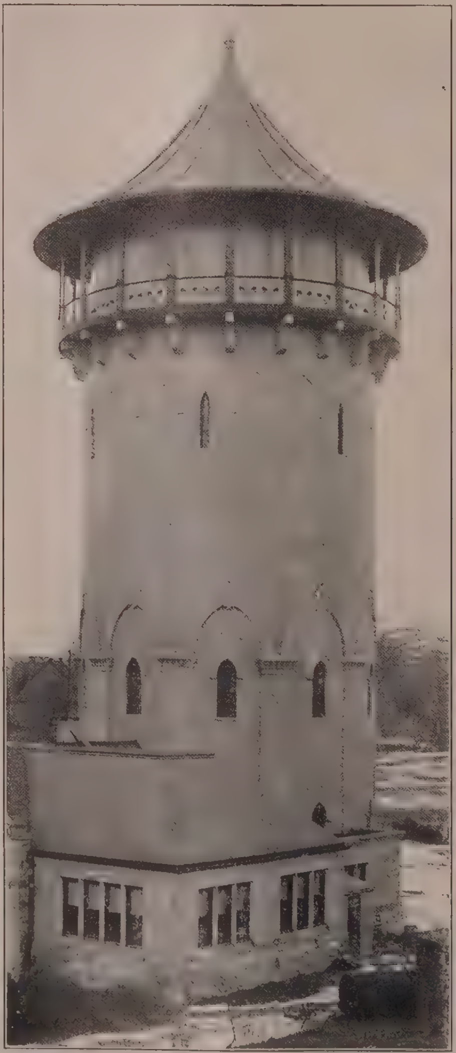
W. S. FARLEY.

San Francisco.

[The Engineering Record joins with Mr. Farley in hoping the subject will be discussed in these columns.—EDITOR.]

An Artistic American Water Tower

SIR: I note in the Engineering Record of July 10, page 48, under the heading "Appearance Considered in German Towers" some sketches, together with a description of two concrete water towers designed by a German engineer. Lest your readers feel that we have to go to Germany for artistic designs of water tanks, I am inclosing a photograph of the Riverside (Ill.) water tower. This structure seems to be more pleasing in appearance than the towers illustrated in your issue of July 10.



RIVERSIDE'S PICTURESQUE WATER TOWER

The brick tower was originally built in 1870 and supported a wood tank which was replaced once or twice and finally, in 1913, burned, although containing water At that time the city officials decided to put in a more permanent installation and retained Dabney Maury and Douglas Graham of Chicago as consulting engineers, with W. D. Mann as architect. Under their supervision the present tank was built by the Chicago Bridge & Iron Works.

The height of the brick tower was increased 20 ft. and a 150,000-gal. elliptical-bottom steel tank was installed. The steel plate roof and ornamentation at the top, as well as the new brick work, were all designed to carry out the appearance of the lower part of the brick tower as originally built, and the resulting structure is generally considered artistic in appearance, besides being substantial and absolutely watertight.

C. S. PILLSBURY,
Chicago Bridge & Iron Works.

Chicago.

Thin Concrete Base, Reinforced, for Pavements

SIR: With considerable interest I have read your presentation of the paper read by Prof. James S. Tucker, director of the School of Engineering of the University of Oklahoma, before the Iowa State Engineering Society. (See the Engineering Record of June 5, page 719.) While the matter will doubtless be discussed more ably by others, I wish to offer a few comments which seem pertinent, and to offer such arguments as occur to me, to prevent, if possible, the acceptance by younger engineers, or others, whose lack of construction experience and desire for an academic economy of construction may mislead them into errors which they will later regret, of any such ideas as are advanced by Professor Tucker.

The slabs used in the experiments were of but 27-in. span, which implies only the narrowest of trenches. A much worse condition would be given by a leaky water main in a street which might saturate the soil for many feet in area. The loads also are much less than would be encountered in ordinary street construction.

Consider, for instance, an asphalt truck of 5 tons or more capacity. Such a truck will weigh empty about 11,000 lb., with the weight about uniformly distributed on four rubber tires, each 10 in. wide, giving a load of approximately 2750 lb. on each tread for truck alone. The load hauled will often equal 15,000 lb., of which 10,000 lb. may be on the rear axle, giving an additional tread load of 5000 lb., or a total of 7750 lb. While it is true that this load is distributed over an area of probably 40 sq. in., due to the flattening of the rubber tires, there is nevertheless the shear upon the concrete to be cared for, and this is no doubt the direction in which the concrete will fail.

The practical method of applying this load is not by careful laboratory placing with even bearing, but at a speed of from

12 to 20 miles per hour with all the shock accentuated by the speed of the truck and the inequalities of the pavements or débris left thereon. And in this connection I will state that my observation shows that the shock of a truck loaded in this manner, as noted on the wood-block paving of a highway bridge, appeared eminently greater on both the paving and the bridge than the passage of a 35-ton, high-speed electric car over the same bridge.

The failure of a concrete base, as noted by the writer, occurs more often than any other way by the successive breaking down of the edge in front of a wheel or roller. The base continues to crumble ahead of the wheel until a place is encountered where the subgrade is hard enough to give adequate support. With the utmost care in preparation of subgrade some soils are of such a character that it is impossible to compact them in a permanently satisfactory manner, and absolute dependence must be placed on the base to support the traffic.

The results of tests made in other cities, as well as those conducted in connection with paving in this city, indicate that with the present methods of mixing concrete, even with the most careful proportioning of materials and accurate grading of aggregates, a compressive strength in excess of 1000 lb. per square inch for a 1:3:6 mixture, or 1500 lb. per square inch for a 1:2:3½ mixture should not be counted on for safe practice. Taking the shearing strength at half the compressive strength we should have 500 and 750 lb. respectively as the shearing strength to be depended on. The stresses to which a concrete base may be subjected are, however, so varied that it is almost impossible to reinforce for them all.

Also, in a somewhat extended experience I have yet to see the contractor's crew which would accurately set the reinforcement in a 3-in. slab when laying base at the rate of 15,000 or 20,000 sq. ft. per day, and unless the reinforcement is accurately set it certainly can have little value.

The statements that a "3-in. reinforced slab is easily as good as a 6-in. plain one," or that "wherever there is need for a 6-in. base one 3 in. thick with five cents worth of reinforcement will do equally as well," will, I believe, not be accepted by practical paving engineers, if applied to paving work. Nor will any engineer who has had experience with old, unknown fills or trenches, leaky water pipes or other defects of foundation difficult or impossible to provide against concur with the statement that we "need not assume that we must design to meet the non-supported condition in practice," for that is one of the assumptions that certainly must be made for a correctly designed paving within certain limits.

The statement of Mac Adam referred to, in which he states that a "well drained and compacted subgrade will bear any wheel loads that could be put upon it," seems to have been doubted by Mac Adam himself, as he promptly superimposed a wearing surface, usually about 12 in. thick, of stone, interlocked and compacted in a manner which brought fame to Mac Adam for all time. It is also to be commented upon that the wheel loads in 1815 were considerably less than those usual in 1915.

Another matter which has not been commented upon in Professor Tucker's article is the matter of cuts in the pavements for utility companies, or other purposes, and the repair of the same. Every city has to contend with this condition, no matter how well its affairs may be handled, and it is but the part of wisdom to prepare for it. For the ordinary repair it is necessary to depend either on the area of the patch for support, or on the mechanical interlocking of the new concrete base with the old, as adhesion is many times imperfect. It will be seen that the thicker the old base the greater will be the strength of the interlocking and also the opportunity for adhesion. As a practical matter a reinforced patch cannot be placed in a reinforced base unless it has an appreciable thickness, and then only with considerable difficulty.

In conclusion, I wish to say that I speak from knowledge of failures of 5-in. concrete bases of accurately and properly mixed 1:3:6 concrete in cases where the subgrade had been thoroughly drenched and then rolled with a 10-ton Macadam roller until practically unyielding, and where the causes of failure were shown to be as stated before, leaky water pipes, hidden springs or old trenches which the roller did not discover to usual inspection.

C. S. POPE,
Engineer of Paving, City of Los Angeles.
Los Angeles.

[The foregoing letter was submitted to Professor Tucker, who replies as follows.—EDITOR.]

SIR: I thank you for the opportunity to comment on Mr. Pope's letter, as well as thanking him for assisting me to emphasize certain points I am trying to make. I read his letter as chiefly dealing with three points: (1) That leaky water mains and wet spots due to other unknown and unseen causes are common; (2) that motor trucking introduces loads not contemplated in the tests described, and (3) that under these conditions pavement foundations have been wont to fail by crumbling ahead of the wheels until a sound subgrade is reached.

There is no argument on any of these points, certainly. Nor do they, in the writer's opinion, affect in any way the validity of the contentions he has heretofore put forth.

Mr. Pope says that on a poor subsoil the foundation must carry, or at least assist to distribute, the load. Assuredly so, but is this any argument for not economically strengthening the foundation? Or can anyone say that even the poorest and wettest subgrade will support nothing? Even water has a marked flotative power! It is plain that bridging out in every direction, as in a continuous slab, suitably reinforced, will assist the foundation to bear the loads otherwise likely to shear through the foundation into the soft subsoil. To hold otherwise is to say that plain concrete is as strong in tension as is concrete substantially reinforced.

It is further felt that the argument for accurate place of the reinforcement here lacks force. It is pertinent where the loads are of known intensity, of definite application, and the points of support or reaction are all clearly defined. But none of these conditions exist here. Hence it is believed that practically it is as reasonable to let part of the reinforcement lie near the top to strengthen against contraflexure as for it all to lie at the bottom of the slab, good only against downward deflection. Since in the practical use of the reinforcing fabric this is just what would usually happen, why not make a virtue of necessity and say that is just what is wanted, because it will always be impossible to tell at which points, precisely, it should lie at the top, and at which at the bottom?

And finally, referring again to Mac Adam's theory of soil support, Mr. Pope draws inferences from the facts quite different from those of the writer. He seems to say that he would put considerable reliance on the load-supporting capacity of a flat arch, built of chips and fragments of broken stone, bound together with water—an arch with no skewbacks or abutments. If the natural soil is not to be counted on as carrying anything under modern trucking, then the soil might be safely washed away from under such an arch with no bad effects on the traffic using it. It is suggested that there are no observations that will warrant such an assumption.

JAMES I. TUCKER,
Professor of Civil Engineering, University of Oklahoma.
Norman, Okla.

Cracking of Brick Pavements Is Prevented by a Mortar "Cushion"

SIR: It may be accepted as a general truth that vitrified brick pavements do not wear out but are destroyed. Though this precept is no doubt occasionally found not to hold, in the vast majority of cases there can be but slight error in the statement as above made.

Comment was made in the editorial pages of the Engineering Record under date of July 3, page 3, of a method of analyzing the causes of brick pavement failures. While the general scheme was therein outlined exceptionally well, it would perhaps be better at this time to review the question, throwing if possible some additional light upon it.

The writer suggests that anyone doubting the validity of the arguments there set forward, should take his hammer and examine the pavements in his own neighborhood. He will find that with but few exceptions the conclusions will be borne out. In these few cases the fault may lie elsewhere, either in too weak a grout, or, what is more probable, in a failure of the foundation. But it may be said with but small chance of successful disproval that few foundations fail. In an article in the Engineering Record under date of June 5, 1915, page 719, Prof. J. S. Tucker shows very conclusively that almost any soil is capable of sustaining the loads normally coming upon it.

It takes not much of an engineering imagination to see that in a type of construction, like the vitrified surface of a brick pavement, very slight deflections will put an extremely heavy compression in the top surface of the pavement. This compression will sooner or later destroy the grout at the top. In areas where the grout near the top has been disintegrated, it is almost universally found that the pavement is hollow, unless the disintegration has proceeded so far that the unsupported area has settled down upon the shrunken sand cushion.

Let the examiner proceed further with his hammer, striking the edges of the brick unsupported by grout. A few light blows will result in a spalling of the corners. Then proceed to a portion where the grout is still intact, due to the fact that the brick rests upon the sand cushion. He may easily wear out his hammer and patience trying to break down the corner of a properly grout-protected brick.

The new specifications of the city of St. Louis contain the following clauses:

BEDDING COURSE

"*General*—The materials for the bedding course must be mixed in a machine satisfactory to the President of the Board of Public Service, or if by hand on a watertight mixing board or pan, or on a clean finished street pavement. Under no circumstances shall the mixing be done on foundation concrete. The materials shall be thoroughly mixed dry until a uniform color is obtained and shall be deposited in this condition.

"*Specific*—The bedding course shall be composed of one part of cement to four (4) parts of sand as specified under Fine aggregate, or clean limestone screenings, if screened to pass through a three-sixteenths (3/16) in. mesh sieve in every direction.

"The bedding course shall be laid not sooner than seven (7) days nor more than fourteen (14) days after the concrete foundation has been finished, unless weather conditions make necessary a longer time.

"The foundation concrete shall be swept clean. When clay or foreign material not easily removed with a dry broom is present, water shall be used.

"The Engineer will test such guides as the contractor may desire to lay for the support of the template which is to true up the bedding course. A guide shall be laid along the center of the street or on the track rail, and the guide at the curb may rest on the curbstone.

"The design for the template and guides for use in finishing the bedding course must be submitted to the President of the Board of Public Service before any of them are constructed, and only such types as he may approve shall be used.

"The bedding course mixture shall be deposited dry upon the concrete. It may be brought to approximate surface by means of shovels, lutes or rakes, but except in inaccessible places, must be finally surfaced by means of the template, the edge of which shall be three and three-fourths (3¾) in. below the surface of the finished pavement."

The writer does not desire to intimate that this is the final form of construction. A still further step in advance has been suggested and put into effect by W. T. Blackburn, consulting engineer of the Dunn Wire-Cut-Lug Brick Company, and Allan Jay Parrish, contractor, of Paris, Ill., who had developed a method of laying which finishes the entire pavement at one operation. [This was described in the Engineering Record of July 10, 1915, page 54.] On the green concrete foundation is spread a damp mortar cushion and immediately upon this course the brick are laid and grouted. The pavement is then a monolith with the bricks forming a structural part of the base, leading to an even greater distribution of load upon the sub-grade and permitting the earlier opening of the pavement by the time ordinarily required for the concrete base to harden. Incidentally the concrete will harden under better conditions, being protected from excessive evaporation by the brick wearing surface and making necessary only one period of sprinkling and protection—that is, the formerly usual period required for the hardening of the grout.

It is the writer's opinion that, under this method of laying, 3 in. of concrete and 1 in. of a mortar bedding course will be sufficient. The strength, as a slab, of 4 in. of grouted brick and 4 in. of concrete, is very nearly the same. In the old style of pavement there was a 4-in. layer of brick and a 6-in. layer of concrete, separated by a sand cushion, through which no horizontal shearing stress could be transmitted. These two layers, therefore, acted as separate structures, and the index of their strength would be $(4 \times 4) + (6 \times 6) = 62$, while under the new form the index would be $(4 + 1 + 3)^2 = 64$.

Since the distribution of the load is a factor not of the strength but of the deflections, a truer index of the value of the new construction would be gotten by the following expression $(4 \times 4 \times 4) + (6 \times 6 \times 6) = 280$ for the old type, and $(4 + 1 + 3)^3 = 512$ for the new type.

There has been altogether too much "Rule of Thumb" in pavement construction. While road-making is one of the oldest outlets for engineering thought, we still have a marvelous faith in the half-foot as a proper thickness for concrete foundations, whether the soil is light loam, sand or solid clay, free from or full of recent excavations; or whether the loads coming thereon are the light loads of residence districts or the heavy loads of teaming sections. It is high time that these factors be considered even as they are in bridge design, for while there is, perhaps, not much danger to life involved in the failure of a brick pavement, there are surely vast economies possible if a little more time is spent over the desk and less on the job itself.

MONT SCHUYLER,
Engineer in Charge, Municipal Testing Laboratory.
St. Louis, Mo.

Common Sense Regarding Academic Freedom

SIR: I have read with great interest your editorial in your issue of July 10, page 35, entitled "Common Sense Regarding Academic Freedom," and I cordially agree with the view which you take of the possibilities of abuse resulting from too great license in the teaching of economics. In my opinion, this country has suffered immensely in the last ten or fifteen years from the over-production of cheap and alluring theories as to finance and economics by sensational writers in the popular magazines, immature and partisan socialists, inexperienced college professors, misdirected sympathizers with the public, and demagogues generally.

There seems to be a well-spread and general idea in this country to-day that economics and finance are not subject to any fundamental conditions, but can be formulated and swayed to fit the sentimental feelings and wishes of the popular desire. This ill-advised propaganda is bearing fruits in bad results all over the country in public and private ill-considered schemes which ignore fundamental economic facts and well-established conditions. It is, for instance, just now conspicuously seen in the attitude of some of the newer public utility commissions and their immature engineering staffs, and it is also preached by the politicians in search of political preference and anxious for the limelight. College professors are not exempt from the alluring and baneful temptation of the use of their positions to disseminate what seem to them to be creative ideas, but which are often in reality pure fallacies long since exploded by practical experienced men in contact with the realities of life.

The engineering profession is not without its numerous regrettable instances of otherwise fairly able men who have yielded to the subtle temptation to ignore the teachings of history and practical experience in favor of some momentarily illusive theory; and while in our colleges it is difficult on the one hand to draw the line between radical attempts to foist imperfect conclusions and crude and visionary ideas upon the younger generation, and, on the other hand, to allow reasonable latitude in intellectual liberty, still there must be a limit in collegiate responsibilities to that license which would permit the instruction of our youth by those who, from some unfortunate cause or another, have no intellectual ballast or grasp on the realities, but who, nevertheless, have been unfortunately selected and appointed to the instructing force or on the faculty. The responsibility for properly drawing a clear line between sound instruction and mental vagary must naturally devolve upon boards of trustees of our colleges.

The American people to-day are in great need of safe and sane views on thrift, finance and sound economics, and that liberty in teaching which leads us away from such important anchorage is dangerous and fallacious and in my humble opinion should not be encouraged.

We have before us to-day the most astonishing example of the results of propagating erroneous ideas in university life in Germany, and we can look with amazement and horror upon certain ideas the results of which are now devastating Europe. These ideas, in some small part, in my opinion, have been due to false theories of the State and of might and right inculcated in German universities, and have been unchecked by conservatism and good sense.

A German professor is now engaged in showing to that country that England logically torpedoed the Lusitania in order to involve the United States in war, and I suppose if he were teaching in this country or in England, it would be set up that intellectual liberty must not be checked, and his propaganda would continue undisturbed.

We do not want our intellectual liberties unduly curtailed, but at the same time we do not want our youth instructed by brain-crazed instructors such as Erich Muenter, or even that milder type of unbalanced minds who ride particular economic hobbies to death, and so set back the advancement of sound common sense among the coming generations.

I am not at all informed as to the University of Pennsylvania situation, and what is said here has no local reference to that case, but it is caused by an increasing regret at the constant disposition on the part of a certain type of gentlemen (some of them titled in halls of learning) to substitute sympathetic prejudices in place of practical experience in economics, particularly when the world is full of facts and experience tending to point out fundamental principles based on common sense.

Let our college trustees, therefore, exercise their trust and live up to their responsibilities whatever may happen. It is their duty to see that the teaching in their colleges is as safely sane as it is informing.

JOHN W. ALVORD.
Chicago.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Barrel Blowoff Trap Stops Noise from Compressors

By WALTER BAZORE
Master Mechanic, Rapid Transit Subway Construction Company, New York City

AN EMPTY oil barrel, with both heads left in, has been used successfully by the writer on the blowoff line of several air plants on aqueduct work for New York City to eliminate all noise. If the line is 2 or 2½ in., it is bushed up to 6 in. one or two pipe-lengths before it reaches the barrel. This allows the air to expand and reduces the pressure considerably before it enters the barrel. The 6 in. line ends with half of a flanged coupling, which is bolted to one head of the barrel. This head is taken out, the hole cut in it, and the flange bolted on. The head is then replaced, and the whole barrel screwed onto the end of the 6 in. pipe by means of the flange.

The barrel is bored full of 1-in. or 1½-in. auger holes, to more than equal the area of the 6-in. line. The air on reaching the barrel is thus able to expand till atmospheric pressure is reached, and escapes through the auger holes without noise. If a larger blowoff line is to be used, it should be bushed up to 10 in. before reaching the barrel.

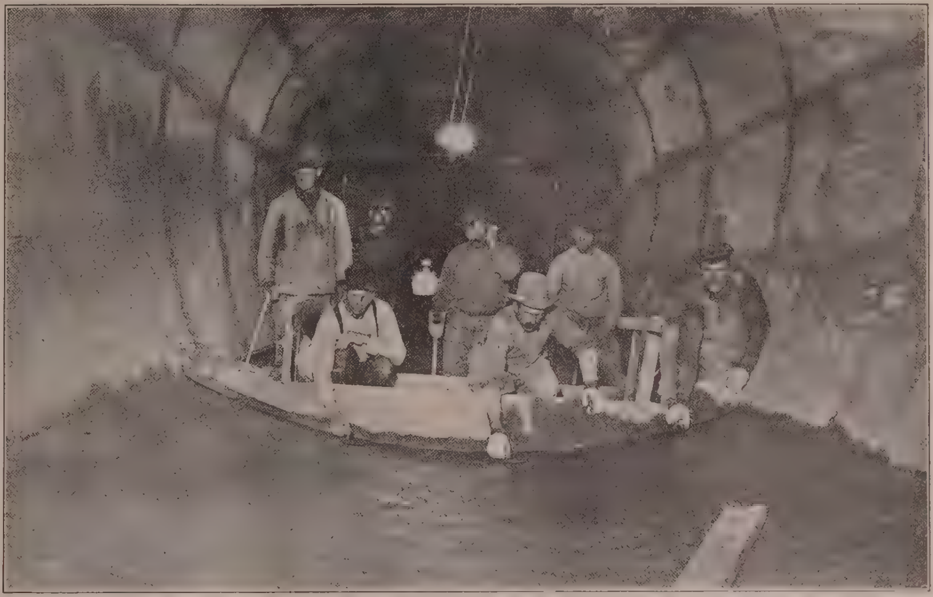
Float Used to Finish Tunnel Floor Concreted Continuously

By H. C. LIGHTFOOT
Gilman, Montana

THE FLOAT shown in the accompanying photograph enabled the contractor for two small tunnels on the Sun River project of the U. S. Reclamation Service in Montana to finish the tunnel invert and at the same time place the invert concrete continuously without a joint from end to end of each tunnel.

The tunnels were of typical horseshoe section with a 9-in. lining. The walls and arch were concreted first, and the invert concreted last. Concrete was brought in from one end of the tunnel, shoveled into place from the cars, and struck off to the approximate shape of the invert with a shovel. The track was taken up as the work progressed back toward the end of the tunnel where the mixing was done. After the concrete was leveled, a float, conforming to the curve of the finished invert, was dragged over it 2 ft. at a time toward the end of the concrete track. Three men stood inside this float, and finished the 2 ft. strip of invert just dragged over while the laborers placed more fresh concrete in advance of the float.

The float was then dragged back and another 2 ft. strip finished. Thus the placing and finishing of the concrete was simultaneous, and was carried continuously without having to leave any joints in the invert. The finishers, of course, worked a sufficient distance behind the point of concreting to give the concrete time to stiffen sufficiently after it was placed to be worked easily. A fairly stiff mixture of concrete was used.



TUNNEL INVERT FINISHED TWO FEET AT A TIME AS IT IS CONCRETED

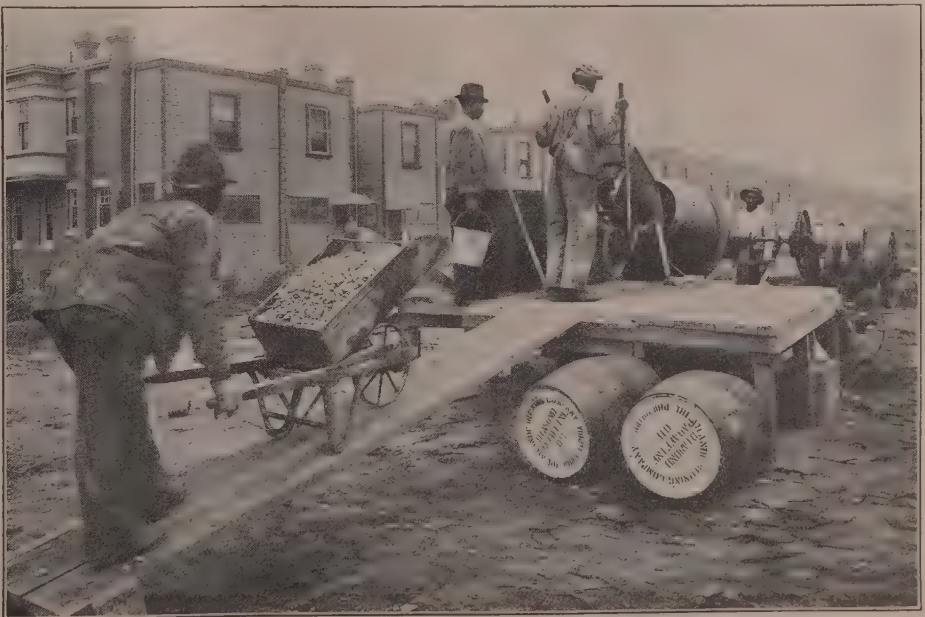
The work is being done for the U. S. Reclamation Service by Olof Olson, subcontractor for McArthur Brothers of New York City.

Devices for Insuring Correct Mix on High-Class Work

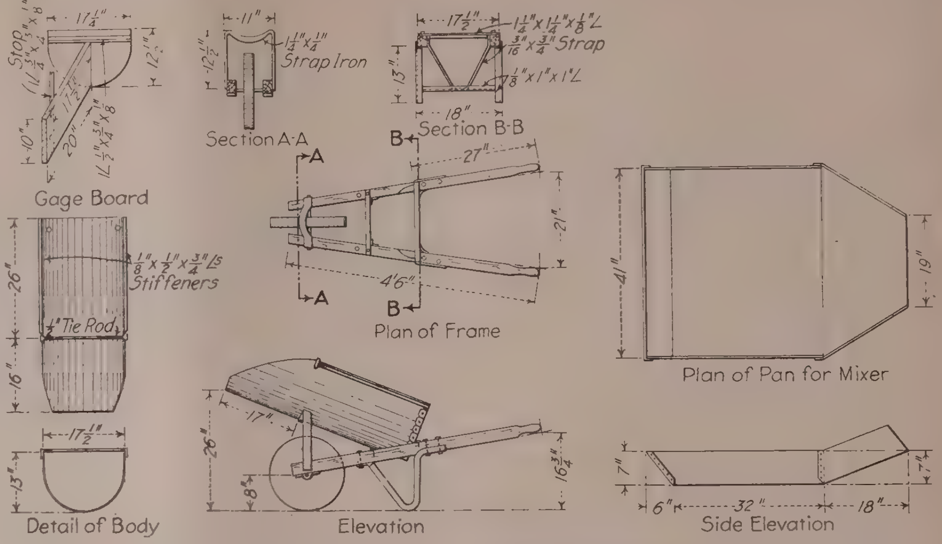
ELSEWHERE in this issue is an article under the title, "Eye is Best Means of Controlling Consistency of Mix," telling why the Lock Joint Pipe Company, of New York, which makes reinforced-concrete pipe, a product requiring high-class workmanship, has selected small mixers of the open type for its work. When it began buying these mixers it realized that schemes would have to be developed in order that they might be used with the greatest economy. The equipment to be described was, therefore, designed. It consists of a special charging barrow, allowing of accurate measurement of aggregate, a support for the barrow while being dumped and a discharging pan.

GENERAL SET-UP

The general set-up is clearly shown in the accompanying photographs. The charging platform is somewhat higher than the bed of the truck carrying the mixer, and is sufficiently large to allow the wheelers to turn conveniently and allow sacks of cement to be piled along one side. A second



BARROW RESTS ON SADDLE WHILE BEING DISCHARGED INTO MIXER



SPECIAL BARROWS, WITH GAGE BOARDS AND DISCHARGE PARTS, HAVE BEEN DESIGNED

runway, for empty barrows, was not in place when the photographs were taken. A water barrel is placed in a handy position on an extension of the platform.

Details of the barrow are shown in the drawing. The one detailed is for use with the half-bag mixer. A larger one is used with the one bag-size outfit. The latter differs from the one shown only in having a larger body. The special advantages of the barrow are:

1. Its compactness and strength.
2. The straight top, allowing the aggregates to be struck off and thus be accurately measured.
3. The ease of varying the proportions of sand to large aggregate,—by merely changing the position of the stop on the gage board.
4. The narrow spout, fitting into the open mixer and thus allowing the latter to be charged without the loss of sand or stone.

USE OF BARROW

In use the sand is put in the barrow first, filling the space between the end of the body and the gage board. The size of this space is determined by the position of the stop on the shank of the gage board, which comes up against the tie rod across the front of the barrow. After the sand is loaded, the board is removed and the remaining space filled with the large aggregate.

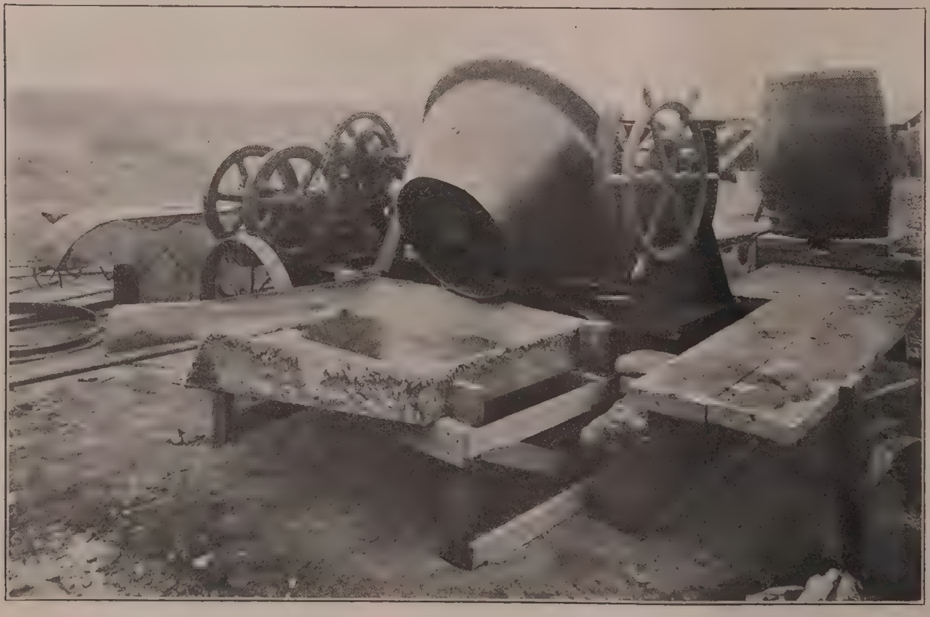
In order to discharge the contents of the barrow into the mixer it is run against an angle-iron saddle (see photo) and lifted as shown. It will be noted that the wheel is thus raised from the platform.

DISCHARGE PAN

On the discharge side of the mixer is a pan with a capacity of 6 cu. ft. It has two advantages: (1) It forms a reservoir for several batches and (2) allows the mix to be inspected. It will be noted that the lip has a rise of 7 in., equal to the height of the sides. The hoe shown in the picture suggests how barrows are filled from the pan.

It will be noted that the frame supporting the pan is independent of the mixer truck. In fact, experience has shown that the frame must not be allowed to touch the truck. If it does the vibration of the engine, communicated to the pan, causes the large aggregate to settle out with surprising rapidity, quickly forming a packed mass that can not be broken up by the hoe.

The devices illustrated have been in a course of development for the past three years, and have enabled the company to secure very satisfactory service from the small mixers, of which it uses two makes—the Little Wonder and the Big and Little.



DISCHARGE PAN HOLDS SEVERAL BATCHES AND ALLOWS MIX TO BE INSPECTED

Follow These Pointers to Avoid Trouble with Blasting Fuse

IN EXAMINING fuse, to see whether the powder core is injured, it is necessary, according to the *DuPont Magazine*, to give consideration to the waterproof covering. This is made of compounds of asphaltum, tar, etc., as well as gutta-percha. If improper materials are used, the compounds may penetrate through the yarns to the powder, and this will give it a very dingy and somewhat sticky appearance, and may be so bad as to ruin it. Powder that is wet will be soft and dingy black in color, but usually after it has been dried it will harden into grayish, lumpy particles. When the moisture has entered from the outside, the white exterior color is usually left in a lusterless, chalky condition.

Fuse may become injured in transit, storage, or handling, and it is important that fuse be stored in a cool dry place. Fuse stored in too warm a place is liable to be affected by the melting of the waterproofing materials, and their penetration to the powder. Fuse should be warmed to a temperature of from 60 deg. Fahr. to 70 deg. Fahr. before uncoiling, because in cold weather the waterproof material becomes brittle and will crack, unless the fuse is carefully handled. Moisture kills the powder, and even when insufficient to actually kill it, its presence retards the burning speed.

Cut off about two inches from each end of the coil before using to be sure that the ends are dry, as the powder may have absorbed moisture from the air. For this same reason it is unwise to cut up the fuse lengths much ahead of actual need unless they are stored in a dry place. Cut off the ends of the fuse squarely, especially where they are to be inserted in a blasting cap. One cut diagonally is apt to fold over and interfere with the spit. For wet holes, the joint of the cap should be made waterproof by an application of waterproof paint or heavy axle grease.

The kind of stemming material used is important on account of the fact that considerable gas is generated by burning fuse, and if it is too closely confined by a material that is not porous the pressure of the gases rises to such an extent that the speed of burning is very much affected. Usually the speed is increased as the pressure rises. In experiments made with moist fire clay as a stemming material, the rate of burning of the fuse was increased over 50 per cent; but with dry sand, moist sand, and dry fire clay the increase in burning rate was comparatively small.

FOR FILING PAMPHLETS, trade publications, bulletins and clipped portions of the proceedings of the National societies relating to subjects of particular interest to the sanitary engineer, Prof. W. C. Hoad of the University of Michigan has extended the Dewey decimal system and placed the papers in wood and cardboard boxes the size and shape of a book to fit into an ordinary book case. Index numbers are pasted on the back of the box.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Sinking Land Wrecks Cement Company's Power Plant

Sudden Drop of Supporting Soil Causes Collapse of Steel Frame Building and 170-Ft. Chimney—Comment by State Geologist D. W. Newland

Without warning about 3 acres of the soil supporting the power plant of the Knickerbocker Portland Cement Company near Hudson, N. Y., rendered fluid by heavy rains, suddenly shifted and dropped downward just before 6 o'clock Monday morning, Aug. 2, and caused the complete collapse of a steel-frame brick power-house, a 170-ft. reinforced-concrete smoke stack, and the sinking of a 20,000-ton pile of crushed rock from a height of nearly 40 ft. almost to a level with the original ground surface. A square concrete elevator tower about 40 ft. high is now leaning at a sharp angle and is half buried by the stone around it. Five men lost their lives in the boiler house and four others were badly injured by being caught in the débris and burned by escaping steam.

Ground Drops 15 Feet

The photographs suggest the nature of the sudden shifting drop of the soft, loamy earth or glacial drift and the resulting damages to

(*Continued on page* 180)

Cloudburst Floods Erie and Destroys Bridges

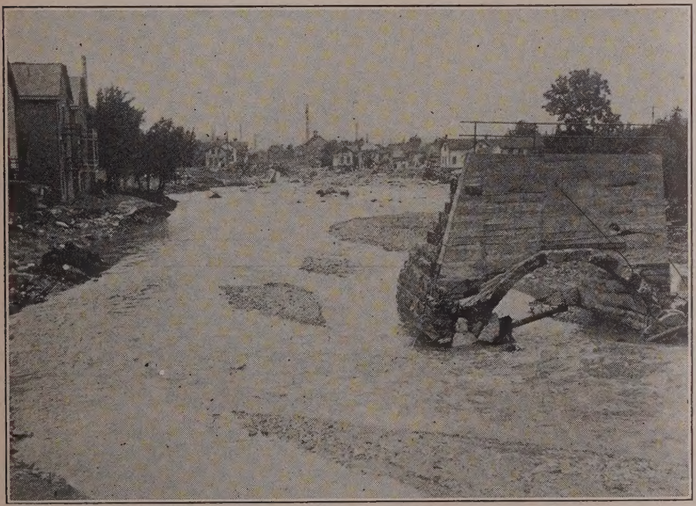
Excessive Rainfall on Aug. 3 Forces Mill Creek Out of Its Banks—Buildings Damaged—Bond Issue for Reconstruction

A 10-in. rainfall on Aug. 3, culminating in a veritable cloudburst about 7 p. m., resulted in the loss of at least a score of lives and property damage aggregating several million dollars at Erie, Pa. Mill Creek, a small stream flowing through the center of the city just one block east of State Street, the main street, rose within 2 hr. to a height of over 6 ft. and spread across State Street. It carried great masses of heavy wreckage which stove in the foundations of buildings and soon caused their collapse. The wreckage accumulated in huge piles, deflecting the course of the torrent so that at one time there was more than 2 ft. of water over State Street.

Mill Creek has a fall of 1 ft. to the hundred through the damaged section. It rises about 5½ miles southeast of the city and empties into Lake Erie. About a mile outside of the city limits it runs between hills, making a fairly narrow ravine, spreads into a pond at Glenwood Park, and falls over a dam 40 ft. wide, built of concrete. The dam is standing to-day, although the earth is washed out at the abutments.

The creek flows through a section composed entirely of sand and gravel and blue slate. It cut through this until a brick brewery building was reached just outside the city limits. The building collapsed and the timbers and wreckage piled up against two low bridges with loose plank decks; the planks floated down with the other wreckage to Twenty-sixth Street, where the first big bridge in the city was reached. This structure was a brick arch with stone abutments. The wreckage clogged the opening so that the water rose behind it to a height of over 20 ft. The bridge finally gave way, except for a small portion which was rebuilt about two years ago. Several bridges with concrete abutments and low timber decks failed, or at least their parapet walls fell off. Eight concrete arches withstood the test, suffering only damage to the steel railings.

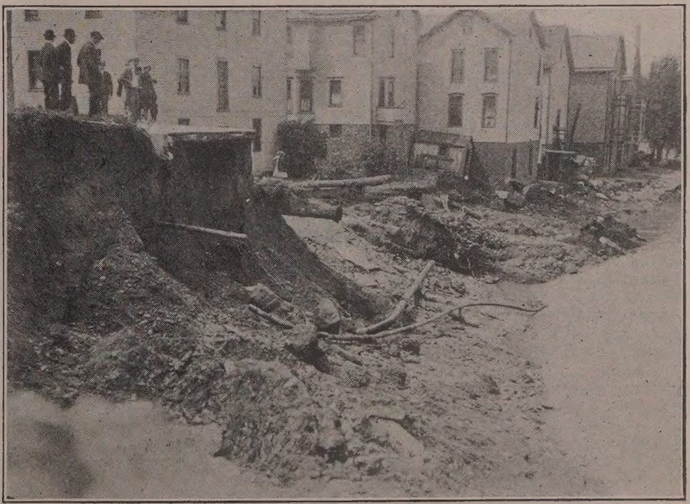
City Engineer Benjamin E. Briggs stated to a representative of Engineering Record that a council meeting to be held before the end of the week will probably arrange a bond issue to defray the expense of restoring the bridges. There have been plans under consideration for some time to divert the stream flow into Walnut Creek, which empties into the lake about 9 miles west of Erie, or building a large enclosed sewer to take the place of the creek.



TWENTY-SIXTH STREET BRIDGE AT ERIE WASHED OUT

SEARCHING FOR BODIES IN THE STORM'S WRECKAGE

DAMAGE IN FRENCH STREET NEAR LAKE SHORE BRIDGE



WASHOUT BROKE SEWERS AND WATER PIPE

Cement Plant Wrecked

(*Continued from page* 179)

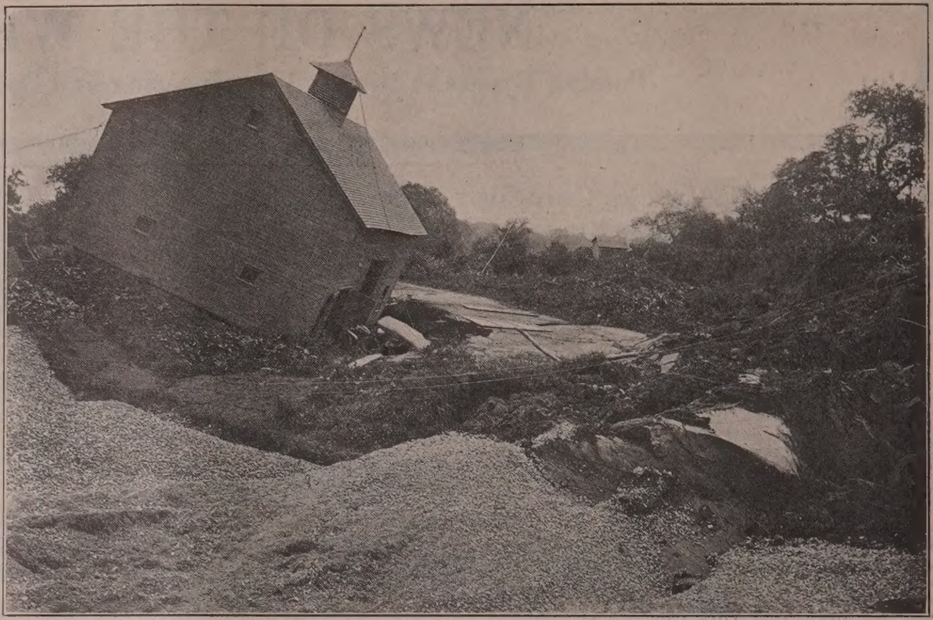
the buildings, which occurred within 3 min. The surface of the ground, which was originally nearly level back of the bluff which dropped about 15 ft. to the bed of Claverack Creek, is now a series of depressions with sharp breaks at which settlements and relatively smaller sidewise shifting are plainly seen, the drop varying from 15 to 25 ft. and occurring in long curving lines which gradually run out several hundred feet each side of the stone pile and power house. A profile view on a section perpendicular to the creek would probably show the present ground surface to lie in a series of at least three sloping steps with steeply inclined upper surfaces, sloping away from the creek. The creek itself has been shifted many feet into a meadow for a distance of about 200 yd.

Supporting Clay a Fluid Mass

D. W. Newland, assistant New York State geologist, made an examination at the site and has sent the Engineering Record the following statement of the probable cause and the nature of the geological disturbance:

"The Knickerbocker Cement Company power-house and smaller buildings were destroyed by the subsidence of the ground, which involved 7 acres along Claverack Creek. The plant is built on a clay terrace, which marks the bottom of an old glacial lake, 200 ft. above tide. The clays at this point are probably 50 ft. or more thick and are the characteristic blue plastic clays that are used along the Hudson River for bricks. The clays are underlain by shales which are solid and compact, free of any cavities sufficient to cause extensive caving.

"The cause of the disturbance is the situation of the lower beds of clays below water level and the heavy rains, forming a fluid mass under the upper firm clays. About 50,000 cu. yd. of limestone piled on the ground, with the weight of the building, overloaded the surface, which consequently collapsed, going down in sections 15 to 25 ft. below the former level. The pressure on the substratum of fluid clay raised the adjoining creek bed 20 ft. above the old level, and several acres across the creek are slightly raised. Numerous dead fish on the dry creek bed show the suddenness of the movement. Rebuilding of the power plant on the present disturbed ground is impracticable. The mill itself lies back of the point of subsidence and its safety is not immediately threatened. Slips of this sort have occurred frequently along the Hudson Valley, coming usually after heavy rains."



VIEW FROM EDGE OF CEMENT PLANT'S STONE PILE, SHOWING SLIP AT SIDE-HILL BREAK

The collapsed power-house is about 90 x 120 ft. in plan, built of steel columns and roof trusses, with brick walls, and erected the latter part of 1910. The reinforced-concrete chimney is 8 to 10 ft. in diameter and 170 ft. high with a heavy concrete base which lifted out as a whole and with unbroken connection with the chimney, which fell toward the uphill side. The chimney was, of course, broken by its fall, although semi-cylindrical portions are still intact for short lengths. The effect on the columns and walls of the power house can be seen in the photographs, the steel withstanding the bending stresses remarkably well. Power-house and chimney were about 150 ft. from the creek.

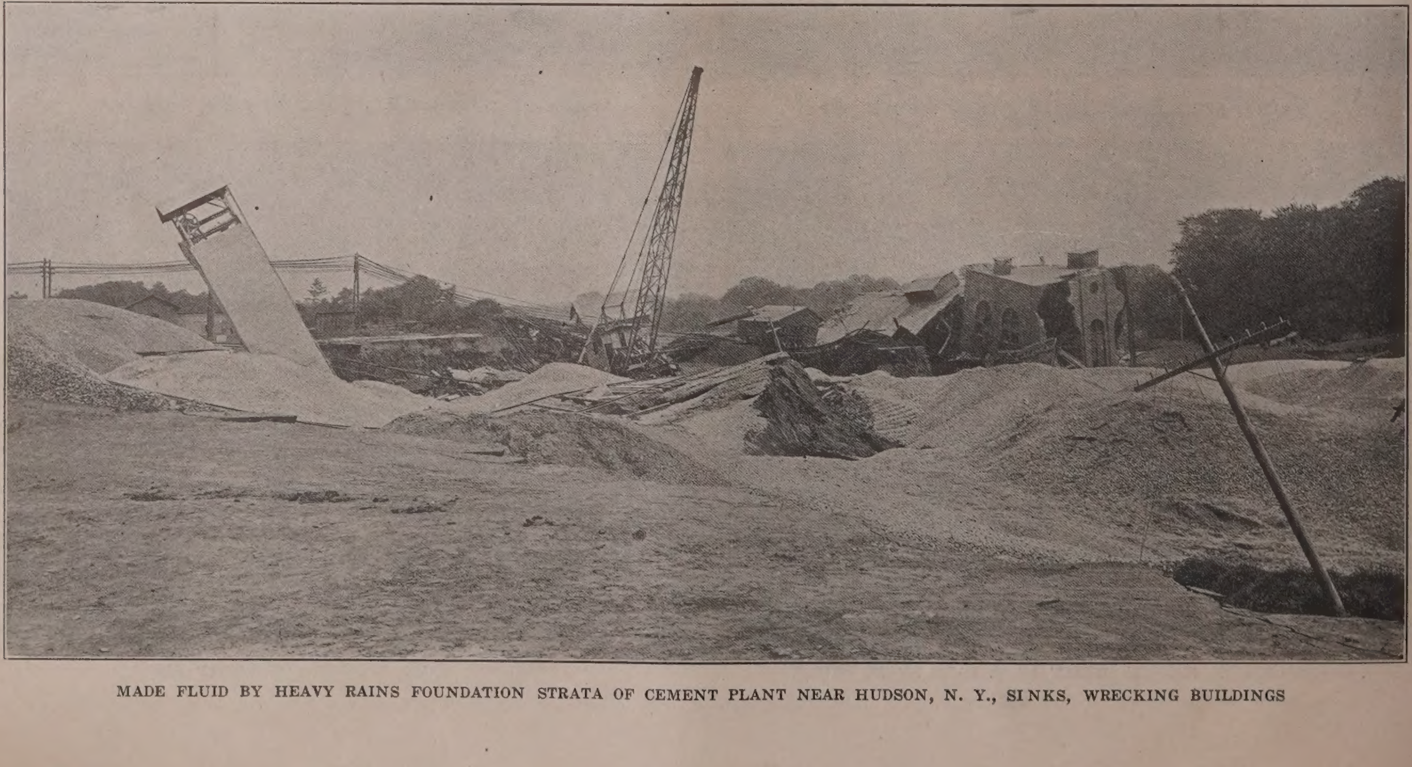
The circular storage system for piling the crushed rock was centered in the 6 ft. square concrete elevator about 200 ft. from the power-house. Stone was delivered to this elevator from the crusher at the quarry by an underground conveyor. The elevator discharged at convenient locations to allow the stone to be rehandled by an electric locomotive crane running on a track of 65 ft. radius and operating a 2-yd. grab bucket to deposit the stone outside the circular track. The total storage capacity was 50,000 to 100,000 tons, although at the time of the accident only about 20,000 tons were in the piles, according to the officials at the plant.

The smaller frame buildings which are still standing, though inclined at sharp angles, are the barn shown in one picture, where a man was just cranking the automobile when the slide occurred, and the bag storehouse at the other end of the disturbed area toward the north.

The general superintendent of the plant, Myron Hammond, has estimated the loss at about $300,000. It will take from four to six months to get the plant in working order. Arrangements may be made temporarily for electric power to operate the mill, the main buildings of which are entirely undamaged.

Texas College Adds New Division to Engineering Department

The Agricultural and Mechanical College of Texas has added a division of railway engineering to its department of civil engineering.



MADE FLUID BY HEAVY RAINS FOUNDATION STRATA OF CEMENT PLANT NEAR HUDSON, N. Y., SINKS, WRECKING BUILDINGS

Court Holds Central Control Filter Patent Claims Valid

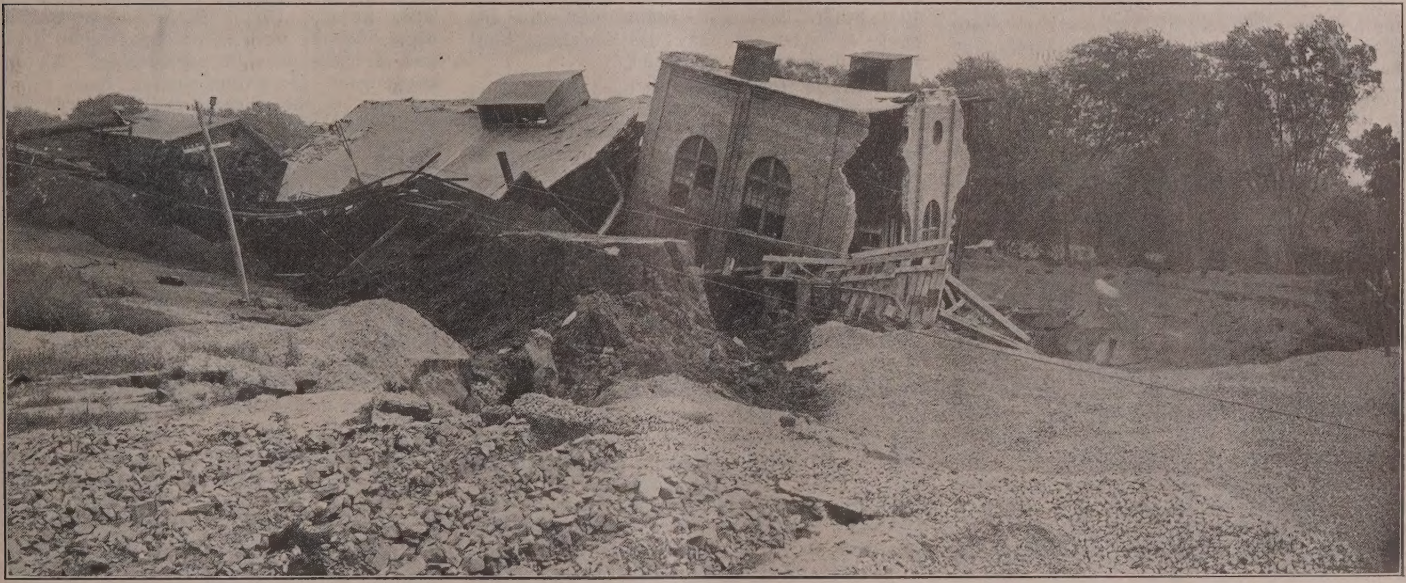
In the Minneapolis filter patent case, which has been pending in the U. S. District Court for some time past, a decision has been reached sustaining two of the Jewell claims. They are summed up in claim 1 of patent 649,110 for central control of operating valves, and in claim 14 of patent 649,411 relating to holding-down screens over gravel layers in a tank having a tapered lower end. The court held that the ridge-block system was a series of tapered lower ends and that Jewell is entitled to the permanent injunction prayed for and an accounting of damages. The holding-down screens at Minneapolis were abandoned a year ago. A royalty on sixteen hydraulic operating tables will have to be paid if the decision is ultimately upheld. The final decree will not be issued for a month.

Severe Storm Visits New York

While it broke no records as to total precipitation or intensity of rainfall the storm which swept over New York City on Aug. 4 was severe enough to do a good deal of damage. The maximum wind velocity was 64 miles per hour from the southeast. From the local offices of the U. S. Weather Bureau the following figures have been secured:

In the twenty-four hours ending at noon, Aug 4, there fell 2.19 in. of rain. The intensities, by 5-min. periods, were as follows: 5 min., 0.05 in.; 10 min., 0.17 in.; 15 min., 0.29 in.; 20 min., 0.37 in.; 25 min., 0.46 in.; 30 min., 0.53 in.; 35 min., 0.58 in.

The maximum previous precipitation for a single day in August was 5.05 in., recorded on Aug. 16, 1909. For this storm the intensities were: 5 min., 0.52 in.; 10 min., 0.97 in.; 15 min., 1.22 in.; 30 min., 1.35 in.; 1 hr., 1.66 in.; 2 hr., 1.80 in.



AFTER THE GROUND SUBSIDED THE STEEL FRAME AND BRICK CEMENT POWER PLANT NEAR HUDSON, N. Y., WAS COMPLETELY DEMOLISHED

Pennsylvania Highway Department to Purchase Turnpikes

The State highway commissioner of Pennsylvania has opened negotiations with a number of turnpike companies with a view to the purchase of their properties so that no turnpikes will exist on State highways. The Pennsylvania appropriation for such purposes for 1915 and 1916 is $250,000, and Commissioner Cunningham believes that great progress will be made if the counties through which they pass furnish the right co-operation and, possibly, financial assistance. In cases where excessive prices are demanded the highway department contemplates either the construction of a road paralleling the turnpike and connecting with the State highways at either end or diverting the money from the county involved to be used for the purchase of turnpikes in other counties where a disposition to play fair is manifested.

Pan-American Road Congress Issues Advance Program

The Pan-American Road Congress has issued an advance program, which outlines the work to be followed at the ten sessions to be held at the Municipal Auditorium, Oakland, Cal., Sept. 13-17. The first session will be taken up with the opening exercises. Addresses will be made by Governor Gates of Vermont, chairman of the executive committee; Governor Johnson of California, Mayor Davis of Oakland and Director of Congresses Barr of the Panama-Pacific International Exposition. Responses will be made by G. W. Tillson, president of the American Road Builders' Congress, and Fairfax Harrison, president of the American Highway Association. The program schedules twenty-one papers open to discussion. A special train has been arranged for, which will leave Chicago Sept. 2, and arrive at Oakland Sept. 12. It will travel over the Chicago & Northwestern Railway to St. Paul, over the "Soo" line to the Canadian border, over the Canadian Pacific, through the Canadian Rockies, to Vancouver and Seattle, and, thence, to Oakland, over the Northern Pacific and Southern Pacific.

Survey Looking to Improvement of New York Harbor Recommended

Comptroller Prendergast of New York City recommended to the Board of Estimate and Apportionment, Aug. 5, that a committee of three engineers be appointed to survey the Port of New York and to report as to what improvements are needed, in its opinion, to bring it to the highest state of efficiency. The recommendation carried with it a proposition to appropriate sufficient funds to defray the cost of the work. Those mentioned as members of the committee are Prof. George F. Swain, past-president of the American Society of Civil Engineers and professor of civil engineering at Harvard University; John F. Stevens, who was, for a period, chief engineer of the Isthmian Commission, in charge of the construction of the Panama Canal, and William C. Loree, formerly general manager of the Baltimore & Ohio Railroad.

$16,200,000 Flood Expenditure Proposal for Los Angeles County

The board of engineers appointed by the Board of Supervisors of Los Angeles County, California, to study the flood control problem reported, July 27, recommending prevention and control methods costing $16,208,900, of which $12,824,400 is for structures and $3,384,500 for right-of-way. The report will be taken under advisement, and any action will be under a State law which becomes effective Aug. 10. This law creates a flood-control district, comprising all of Los Angeles County south of the north line of township five, San Bernardino base line, excepting the islands.

The report takes up all phases of the subject. Conservation of the run-off by diversion into the gravels in the headwater district, retardation of the run-off by contour plowing, reforestation and impeding dams, and stream diversion in the coastal plains, are all recommended. Under the last head there is recommended the changing of the mouth of the Los Angeles River from the harbor, at San Pedro, to Alamitos Bay.

Prospects are that the preliminary steps, in the way of securing final plans and proceeding with the necessary legal steps, will be pushed at once, the flood loss of over $10,000,000 in the early part of 1914 having aroused the public to the need for preventive and protective measures.

This Organization Would Aid the Average Engineer

The American Association of Engineers, an organization drawing members from all branches of the engineering profession and designed to promote the interests of the "commoner" or average engineer, has recently been formed in Chicago, with a charter membership of 300. The association aims to bring recognition to the average engineer in the following ways: By affording means for the interchange of information, maintaining a service clearing house, affording patent and legal advice, supervision of legislation and by proper publicity. The offices of the association are Room 1056, 29 S. La Salle Street, Chicago.

One Hundred Reservations Made for Engineering Congress Special

Reservations have been made for about one hundred persons on the special train to the International Engineering Congress to be held at San Francisco, Sept. 20-25, up to July 27, according to G. S. Harner, passenger agent for the New York Central Lines.

News of Engineering Societies

The Engineers' Society of Western Pennsylvania made an inspection of the Magnolia cut-off improvement of the Baltimore & Ohio Railroad, July 17, as guests of A. W. Thompson, vice-president of the road. This work, which is situated at the east end of the Cumberland Division, cost $6,000,000 and resulted in a shortening of the line of 5 4/5 miles in a distance of 11 4/5 miles.

Personal Notes

G. McArthur has resigned from the office of city engineer of Regina, Sask.

A. J. Widmer, contracting engineer of St. Louis, has removed his offices to the Century Building.

Alvord & Burdick, of Chicago, have been retained as consulting engineers on the Franklin County, Ohio, conservancy district.

H. G. Batten has resigned from the office of supervisor of bridges and buildings of the Detroit division of the Grand Trunk Railway.

Joseph F. Karnes has been appointed junior structural engineer on the forces of the Interstate Commerce Commission, at Chattanooga, Tenn.

R. M. Mark has been appointed assistant engineer on the forces of the New York State Highway Department, with headquarters at Rochester.

B. J. Finch, formerly engaged on road work in the National parks, has been transferred to Portland, Ore., to take charge of road work in Division 6, U. S. Forest Service.

P. S. McCallen, formerly connected with the Morgan Engineering Company of Memphis, Tenn., is now connected with the Jackson Iron & Bronze Works of Jackson, Tenn.

H. T. Power, who has been a member of the California board of water power control since 1911, has been appointed chief engineer for the water commission of that State.

G. H. Frith has been appointed acting assistant engineer of the Belleville division of the Grand Trunk Railway, with headquarters at Belleville, Ont. He succeeds George A. Butler, resigned.

J. Russel Ellis, formerly principal assistant city engineer of Regina, Sask., has been appointed acting city engineer, succeeding G. McArthur, whose resignation is noted elsewhere in these columns.

D. C. Miller, for the past year assistant professor of civil engineering of the Agricultural and Mechanical College of Texas, has been appointed associate professor of civil engineering at that college.

C. C. Jones has been appointed supervisor of bridges and buildings of the Detroit division of the Grand Trunk Railway, with headquarters at Detroit. He succeeds H. G. Batten, whose resignation is noted elsewhere in these columns.

John J. L. Houston, who, until recently, was connected with Jacobs & Davies, consulting engineers of New York City, is now connected with the office of the division engineer maintenance-of-way of the New York Central Railroad, at Oswego, N. Y.

Paul Hansen, engineer of the Illinois State Water Survey, has been given a leave of absence to organize the new sanitary engineering bureau of the Illinois State Board of Health. He has the title of acting chief engineer and will hold the position until such time as civil service examinations are held and some one has been certified.

John W. Ash, civil engineer and contractor, formerly of Chattanooga, Tenn., has removed to Corvallis, Ore., where he is erecting a plant and installing machinery for the manufacture of cement sewer pipe, drain tile and other products of a similar nature. He is also starting work on the construction of a reinforced-concrete pavement for which he was recently awarded a contract.

H. S. Philips has been granted leave of absence from his duties with the Department of Public Works of the city of Toronto, Ont., to accept a position as assistant engineer in the Buffalo office of the International Joint Commission, which is engaged in studying means for the control of the pollution of Niagara River, under the direction of Prof. Earl B. Phelps of the U. S. Public Health Service.

Oro McDermith, formerly assistant project manager of the Salt River irrigation project, U. S. Reclamation Service, has been appointed manager of the Rio Grande project, with headquarters at El Paso, Tex. He was graduated from Colorado State Agricultural College in 1902 and has been engaged continuously in hydraulic work since that time. He was appointed assistant engineer with the U. S. Geological Survey in 1903 and entered the U. S. Reclamation Service in the latter part of 1904.

The Snare & Triest Company, contracting engineers, Woolworth Building, New York City, has purchased the business, good-will, plant, plans and records of R. P. & J. H. Staats, Inc., who, for 27 years, have been established in New York City as engineers and contractors on the design and construction of piers, sheds and similar harbor work. R. P. Staats has retired from active business and J. H. Staats, having secured an interest in the Snare & Triest Company, has associated himself with it as vice-president.

Wilson T. Howe, who has been engaged on hydroelectric work and waterworks construction at Greenville, Tenn., Allendale, N. J., and Henniker, N. H., since 1912, is now connected with the office of the city engineer of Salem, Mass., on the construction of that city's new high pressure water supply system. The work includes the construction of a concrete covered 10,000,000 gal. reservoir, the laying of 5 miles of 36-in. cast-iron mains and the installation of a new pumping plant. Previous to 1912 Mr. Howe worked three and a half years in the Philippine Islands.

Prof. A. C. Love, for the past two years associate professor of civil engineering at the Agricultural and Mechanical College of Texas, has been appointed professor of the recently created division of railway engineering at that college. He was graduated from the Agricultural and Mechanical College in 1899 and, after about three years spent as assistant professor of drawing there, entered the railway service on the forces of the Gulf, Colorado & Santa Fé Railway. He also served on the Atlantic system of the Southern Pacific Railway and was resident engineer in charge of the construction of the first ten miles of the Stockdale-Cuero extension of the Galveston, Harrisburg & San Antonio.

Mayo Tolman, whose appointment as director of the division of sanitary engineering of the West Virginia State Board of Health was noted in these columns last week, is a graduate of the Massachusetts Institute of Technology and has had experience in the health departments of two other States. He was first employed as assistant in the engineering department of the Massachusetts State Board of Health, from which position he resigned to accept an appointment as assistant engineer in the bureau of sanitary engineering of the Maryland State Board of Health. Later he was appointed resident engineer in charge of the western district of Maryland. He received his appointment as director of the West Virginia sanitary engineering division about the middle of June and opened the office, July 1.

F. E. Chesley, formerly resident engineer for the city of Beaver Falls, Pa., on the construction of the sanitary sewer system recently completed there, has been appointed resident engineer in charge of the construction of a sanitary sewer system at Downingtown, Pa. He was graduated from the State University of Iowa in 1904 and was engaged, until the end of that year, in the office of the city engineer of Iowa City. From 1905 to 1908 he confined himself almost exclusively to concrete work. As resident engineer for the Iowa Engineering Company of Clinton, from 1910-1912, he had charge of the construction of waterworks systems in various towns in Iowa. He was appointed an inspector for the Corps of Engineers, U. S. A., at Sterling, Ill., in 1912, and resident engineer on the Beaver Falls work in 1913.

Black & Veatch, consulting engineers, of Kansas City, Mo., have succeeded to the business of the firm of Worley & Black. E. B. Black, who has been with the firm of Worley & Black since its organization in 1909, and N. T. Veatch, who has been with the original partnership for the past four years, constitute the membership of the new firm. Previous to his connection with Worley & Black, Mr. Veatch was assistant engineer for the Kansas State Board of Health and was, for a year and a half, with the American Waterworks & Guarantee Company of Pittsburgh. J. S. Worley, one of the original partners, resigned from the firm early in 1914 to devote his entire attention to the work of the Interstate Commerce Commission, Division of Valuation. The offices of Black & Veatch are located in the Inter-state Building, Kansas City.

E. W. Lewis, formerly assistant engineer on the New York, New Haven & Hartford Railroad, at New Haven, Conn., has opened an office at 234 Union Street, New Bedford, Mass., for the purpose of engaging in a general practice of civil engineering. His first engagement along engineering lines was as assistant in the office of the city engineer of Somerville, Mass., from 1874 to 1876. From 1877 to 1879 he was engaged on Government land surveys and townsite work in North Dakota. He entered railway service, as leveler on the Northern Pacific, in 1879, and continued in this service until 1897, attaining, in 1878, the grade of assistant engineer. For the next two years he was engaged, as U. S. inspector, on harbor improvement work at Duluth, Minn. In 1899 he returned to the Northern Pacific as assistant engineer. He was appointed assistant engineer on the New York, New Haven & Hartford about nine years ago and retired from that office in October, 1914.

Gerard H. Matthes, formerly division engineer in charge of flood investigations in Pennsylvania, for the State Water Supply Commission, has joined the engineering staff of the Miami Conservancy District, with headquarters in the City National Bank Building, Dayton, Ohio, to engage in the flood prevention work in the Miami River valley. He was graduated from Massachusetts Institute of Technology in 1895 and, after a year spent as draftsman and instrument man for the town of Brookline, Mass., served as instrument man for the Massachusetts State Board of Harbor and Land Commissioners on soundings in Boston Harbor and the plane table survey of the Connecticut River. He was engaged for several years with the U. S. Geological Survey on hydraulic and reclamation work, and entered the U. S. Reclamation Service in 1903 as district engineer. He was principal assistant engineer in the hydroelectric department of the American Waterworks and Guarantee Company of Pittsburgh for more than two years, resigning from that office, in 1914, to accept an appointment with the Pennsylvania State Water Supply Commission, in which service he continued until recently.

Obituary Note

Charles D. Ward, who was identified with many well known engineering works previous to his retirement from practice some years ago, died in New York City, July 30, at the age of seventy-eight years. During the latter years of his life he specialized in waterworks, being connected, at one time, with the Providence (R. I.) system as principal assistant engineer, and later, with the Brooklyn, New York City, water department. He was admitted to membership in the American Society of Civil Engineers in 1869.